Newman Community Conservation Area Master Plan

Initial Study and Proposed Mitigated Negative Declaration

March 2021

APPENDIX F: MDTW Project Technical Memoranda

Redtail Consulting
Environment & Community

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UNIVERSITY OF CALIFORNIA
MERCED

NEWMAN CONSTRUCTED TREATMENT WETLAND WATER BUDGET REPORT (Memorandum 2)

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DRAFT

Prepared by

Naivy Dennise Rodal Morales, Ph.D. Student, Environmental Systems Graduate Group

Dr. Marc Beutel, Associate Professor, Civil and Environmental Engineering, Environmental Systems Graduate Group

Collaboration of Cameron Zuber and Anshika Kandhway, Ph.D. Students, Environmental Systems, Graduate Group

1. SUMMARY

The present report covers a detailed estimation of the water budget information for Miller Ditch (MD), in Newman City, that will potentially be treated in a future constructed treatment wetland and reapplied on City agricultural land for irrigation purposes. The implementation of the constructed treatment wetland may allow another source of water for the City's agricultural land currently irrigated with treated wastewater that is lower in salinity and other contaminants. The combination of these two water sources would allow better water management for the City's agricultural land and possibly increase yield and profits while protecting and enhancing ground water quality.

This report, Memorandum 2, includes a description of the treatment area, field measurements of flow rates, water balance calculations and hydrologic scenario generation with estimated outflows and water retention time. Three scenarios assessed include: (1) a normal year using median values of monthly average data of rainfall and evapotranspiration, and average monthly volumetric inflows; (2) monthly assessment to show seasonality of winter versus summer conditions based on a "dry" year (20th percentile monthly precipitation) and a "wet" year (80th percentile monthly precipitation); and (3) three short-term storm events with 50th, 90th and 95th percentile 24-hour precipitation values.

The results show that the main inflow contributing to MD is Q_{MD}, water originated from the Main Canal that is diverted to the agricultural land south of the ditch to service Central California Irrigation District (CCID) customers. According to the field measurements of flow in MD, taken on September and October 2019, and March 2020, flow fluctuates between 8,500 m^3/day and 460 m^3/day and it is mostly dependent to the irrigation season. Therefore, for water balance calculations, from March to October a high value was used as the water is applied to the crops and flows through the ditch. Then, from November to February the value is lower because the irrigation season is over. However, it is acknowledged that the water flow does not completely follow that pattern, as it will depend on the water use patterns of CCID costumers. Other contributors to the total inflow to the wetland is storm runoff from Agricultural area (Q_{CA}) with estimated area of 7,820,000 m^2. Monthly average flows to the treatment wetland in a normal year of precipitation and evapotranspiration range from 2,070 to 27,707 m^3/month considering 30-acres (121,406 m^2) of treatment wetland area. Other inflows and outflows (e..g, groundwater in/out flow, bank loss) are assumed zero due to climate conditions and design-construction recommendations to avoid bank and infiltration loses.

Water balance showed an outflow of 220,127 m^3/month with an average hydraulic residence time of 9 days during a normal year, assuming a 30-acre treatment wetland with a depth of 0.5 m. The seasonality demonstrates the highest flows at the beginning and at the end of the irrigation season, medium flow during the summer months and low flow in winter months when there is no irrigation and there is slow seepage. Precipitation has a small impact during the winter months and the evapotranspiration effect is noticeably during the summer months.

However, the inflows are not governed exclusively by natural phenomenon of precipitation and evapotranspiration, and they are mostly regulated by the agricultural season; therefore, the major inflow contributor is MD flow followed by the agriculture land storm runoff. Moreover, the monthly annual average outflow resulted during the wet year is twice the dry year with 305,636 m^3/month and 172,690 m^3/month, respectively. This is equivalent to an annual average residence time of 6 days in a wet year and 17 days in dry year. Finally, the 24-hours extreme storm event scenarios showed that the wetland could handle these events, but with low removal as the retention time is less than 5 days. The 50th percentile 24-hour storm event resulted in a modeled wetland outflow of 13,041 m^3/d. This value increase over 5-fold for the for 95th percentile 24-hour storm and nearly 10-fold for the 99th percentile 24-hour storm.

2. INTRODUCTION

Newman city is located in Stanislaus County where agriculture is the dominant industry and occupation. The City is part of two hydrological areas, Patterson and Los Banos, of the Delta-Mendota Canal Hydrologic Unit in San Joaquin Hydrologic Basin according to the California Water Code (section 13240) and the Federal Clean Water Act *(California Regional Water Quality Control Board, 2018) (Fig. 1).* The California Department of Water Resources (DWR) established the Delta-Mendota Canal Hydrologic Unit as a high-priority groundwater basin based on adverse impacts on stream flows and overdrafts, among other factors *(Fig. 2 and Table 1; DWR, 2019);* therefore, the region around Newman City is considered in this high priority category for water management. However, agricultural areas around the City still irrigate using water from groundwater reserves and from CCID's Main Canal.

Given the dependence of local agriculture on CCID imported water and regional groundwater, and the critical status of this resource, the City is being cautious in managing and conserving its water resources. Thus, the Newman City has come up with a progressive and sustainable solution to treat and re-use stormwater runoff and irrigation flow-through water nearby the City. Part of the solution is the construction of a treatment wetland that UC Merced is studying, and that will be designed to treat

agriculture runoff and irrigation delivery through-flow from the south area that conforms MD (*Figs. 3 and 4)*.

Currently, water in MD flows north along MD, once reaching the northwest corner it flows east through the northside and eventually flows into the Newman Wasteway. At high flows, the water flows into the North Grasslands Wildlife Area which is managed by the California Department of Fish and Wildlife. Whether through the Wasteway or wildlife area, the water eventually reaches the San Joaquin River (*Fig. 3*). The proposed treatment wetland will be a semi-closed system with MD flow into the wetland for treatment of nitrate and phosphorus which are expected to decrease. Cleaner water from the wetland will be discharged back to MD and/or used for irrigation purposes and eventually groundwater recharge.

The aim of this report is to present detailed estimations of water budget for the proposed 30-acre treatment wetland area. Through this study, an effort has been made to understand the annual, seasonal, and extreme storm variances of inflow into the wetland. The report incorporates description of treatment area, field measurements, water balance calculation, and scenario generation methods, as well as estimated treatment wetland outflows and water retention time for the annual events. This information will be used in the modeling report (Memorandum 4) to predict the effectiveness of pollutant removal for nitrate and total phosphorus in the proposed wetland.

3. METHODS

The City has acquired 78-acres of land for their project, and of the total area around 10-30 acres (40,469-121,406 m^2) are allocated for the construction of the wetland to treat water from MD. Likewise, the wetland will be located in an area with mostly sandy clay soils (RICK, 2019), which can affect the amount of water that flows through the wetland by increasing the infiltration rate; estimations of this calculations are presented in the next section. Moreover, the top of the groundwater table has been reported to be relatively shallow and ranges from 2.4 m (Reyes, pers. comm. 2019) to 3.7 m (Cortez and Marin, pers. comm. 2019), which enhances infiltration and drainage from groundwater to MD.

Water Balance

For a better understanding of proposed wetland functioning and pollutant removal efficiency, the foremost concern is to manage its inflow and outflow because the water budget dictates water treatment efficiency and design. To budget the flows, a water balance for treatment wetland is calculated using the following equation from

Kadlec and Wallace (*2008; Fig. 5),* which represents the difference in volume (storage) at certain time (eq. 1):

$$Q_i - Q_o + Q_C - Q_B - Q_{GW} + Q_{SM} + (P \times A) - (ET \times A) = \frac{dV}{dt}$$

where the values represent volumetric water entering or exiting the wetland such that Q_i is water flowing into the wetland, Q_o is water flowing out of the wetland, Q_C is water flowing into the wetland due to precipitation from the surrounding wetland catchment area, Q_{GW} is water gained or lost to groundwater, and Q_{SM} is water entering the wetland from snowmelt. Precipitation falling into the wetland is represented as the amount of precipitation (*P*) times the surface area of the wetland (*A*); and water lost through evaporation from the water surface and transpiration through plants is represented as the rate of evapotranspiration (*ET*) times *A*.

We assumed that there is a steady-state condition, that is, the volume of water in wetland is not changing overtime; and a 30-acre area for the constructed wetland. Thus, the outflow rate (Q_o) was calculated using the following formula (eq. 2):

$$Q_i - Q_{GW} + (P \times A) - (ET \times A) = Q_o$$

Since, the amount of water flowing into the potential wetland area was not available, Q_i was determined by in-situ measurements and estimations of other inputs using the following formula with Q_{MD} as the remaining flow in MD at the proposed wetland, and C_A for the agricultural catchment areas that have precipitation runoff flowing into MD multiplied by k_A which is the runoff coefficient for the land type used to determine the amount of precipitation-related runoff (eq. 3):

$$\boldsymbol{Q_{MD}} + (P \times C_A \times k_A) = Q_i$$

Using infiltration rate value from RICK Engineering's double ring infiltration test, groundwater infiltration loss from the wetland can be calculated using the formula below, where *I* is infiltration rate of soil and *A* is area of wetland (eq. 4):

$$Q_{GW} = I \times A$$

Combining all the equations above, result the following formula to calculate Q_o (equ. 5):

$$\boldsymbol{Q_{MD}} + (P \times C_A \times k_A) - (I \times A) + (P \times A) - (ET \times A) = Q_o$$

Another important variable when determining the design and operational strategies that affect pollutant removal in wetlands is the hydraulic detention time (τ), which is the measurement of the average of time that water will stay in the reactor, in this case the wetland, and is associated with available time to treat pollutants in the water. It was calculated as the volume divided by the average of the inflow (Q_i) and outflow (Q_o) (eq. 6):

$$\tau = V \ / \ (Qi + Qo)/2)$$

Volumetric inflow into the wetland (Q_i) was determined by measurements of MD flow (Q_{MD}) at the proposed wetland area and through calculations of precipitation runoff into MD from the surrounding agriculture (C_A) land (*Fig. 3*) as mentioned above. On the other hand, the outflow is calculated based on the water balance model using the 30-acre of area. For the average year, Q_o was around 89% of Q_i, thus on average 10% of the water flowing into the wetland is lost to evapotranspiration. Finally, it was assumed a depth of 0.5 m to calculate the volume of water in the wetland (*V*) of 60,703 m^3.

- **Miller Ditch Flow**

A reconnaissance of MD was performed at publicly accessible locations between the proposed treatment wetland area to CCID's Main Canal (*Fig. 6*). Based on structures present, it seemed that water in MD is originated from the Main Canal. Flows in MD may be halted between the middle of November and beginning of February, when flows might be diverted to agricultural land south of the ditch to service CCID customers generating a slow seepage. Based on this information, it was assumed flow in MD was representative of baseline flows in all MD (Q_{MD}) at around 8,500 m^3/d (Guintini and McCurdy, CCID, pers. comm. 2019). (Note that this assumption may not be correct. Recent monitoring suggests flow in MD for May and June 2020 was only around 400 m^3/d. Ongoing monthly monitoring will help to inform and revise this water balance in the future).

During the sampling events flow measurements were taken at the proposed treatment wetland area throughout MD on September 12th and 27th, October 25th, 2019; March 13th, 2020 and June 29th, 2020. The surface method from Turnipseed and Sauer (2010) was used to measure surface velocity in the center of MD over an approximate 3.5 m (11.5 ft) and 9.1 m (30 ft) distances using a neutrally buoyant object with one to three surface velocity measurements. Surface velocity measurements for each day were averaged and converted to average velocity by using a 0.9 coefficient to translate peak surface centerline velocity to average cross-sectional velocity. The wetted width and depth of MD's canal were measured with a tape measurer, or estimated if measurements were unsafe, to estimate cross-

sectional area, and flow was calculated as average velocity times area. Recently in June 2020, flow measurements were estimated at a wooden weir structure by measuring the time it takes to fill in 5-gallon bucket with water, as well as measuring the diameter of the bucket and the length of the whole weir to find the ratio relation to multiply by to estimate for the total flow over the weir.

- **Land surface runoff**

Agricultural (Q_{AR}) catchment area was determined by delineating the runoff contributing area based on elevation from Google Earth (Google LLC, Mountain View, CA) (*Fig. 3*). The geographical area was estimated using ArcGIS 10.2 (Environmental Systems Research Institute, Redlands, CA) with values of 7,820,000 m^2. To calculate runoff generation from this land during storm events, the area was multiplied by the runoff coefficient which depends on the type of soil and slope of the area. A coefficient of 0.5 was used for agricultural land runoff into MD (k_A) which is based on values from USDA (1986) for cultivated agricultural area with clay loam soil and zero to five percent slopes. Using the SoilWeb, it was found that most of the agricultural land around the ditch follow this soil type and slope (California Soil Resource Lab, Davis, CA). While mounded banks were observed along MD, some drainage pipes from the agricultural land into the ditch were also observed (*Fig. 6*, top); therefore, all runoff was assumed to flow into MD.

- **Precipitation**

Precipitation (P) was determined from monthly rain measurements from the National Oceanic and Atmospheric Administration (NOAA) for Newman, CA from 1950 to 2018 (Station ID: GHCND:USC00046168). See *Table 3* for more information on data. If precipitation data was missing (e.g., field blank), the complete month was removed from data. NOAA data was then sorted by month. The 20th percentile (dry year), 50th percentile (median year), and 80th percentile (wet year) was calculated using the Percentile.Inc formula in Excel for each month for the multiple scenarios (*Fig. 7*). These percentile measurements were also used to calculate water balance pertaining to catchment runoff and precipitation into wetland.

- **Evapotranspiration**

Evapotranspiration (ET) data was used to determine water loss from wetland from plant transpiration and evaporation from water surface. ET was determined from Western Regional Climate Center (WRCC) website using nearest station in Los Banos, CA (Station no. 045120). The WRCC station used average pan evaporation data for period of record from 1968 to 2005 (*Table 3*).

- **Other inflows**

Some other values were assumed to be zero for the water balance equation. First, given the Mediterranean climate of the area, it was assumed that no snow contributes with the inflow (Q_{SM}). Secondly, surrounding catchment area (Q_C) do not flow into the proposed wetland area or flow into MD if any, is captured as Q_i in the water balance calculations. Third, it is assumed that during construction of wetland, water losses through banks (Q_B) would be minimized. Thus, they were all considered zero for the purpose of the calculations.

Finally, the calculations for groundwater loss rate (Q_{GW}) resulted in a value of 14,921 m^3/d using equation 4 and infiltration rate of 12.3 cm/d from RICK (190156-001 Geo.Report, Infiltration Tests, 2019). As the resulted value was greater than the measured flows in MD (in average 533 m^3/d), this groundwater loss rate would exceed the amount of water flowing into the wetland yield no flow out (Q_o). Therefore, it was determined that Q_{GW} would need to be minimized through the design of the wetland (e.g., clay liner on the bottom). Thus, Q_{GW} was assumed to be zero for the water balance calculations. However, it is acknowledged that new infiltration rate measurements are also needed in the wetland area, as the value used is from a station near MD and might be higher than other parts of the study site.

Scenario Generation

Estimated water flow scenarios in the wetland were applied to further enhance the understanding of variation in flow through the years with normal, scarce, or ample rainfall, the seasonal patterns, and during extreme storm events. Since we have limited area for the wetland (30 ac), it becomes more important to investigate the water balance to manage the hydraulic retention time (τ) of incoming water in the wetland. Enough time of 5-10 days is optimal and needed to ensure reasonable removal of pollutants in the treatment wetland.

1. Normal year rainfall was calculated using the median values of monthly average data of rainfall and evapotranspiration, and average volumetric inflows. For the calculated balance, outflows were studied separately for winter and summer months.

2. Dry and wet years were estimated using monthly averages for each month over 68 years, which were divided into 20th and 80th percentiles. Twentieth percentile and lower values were considered dry years whereas, 80th percentile and above were considered wet years (*Table 3*). Comparatives were drawn among the inflows and outflows for these two categories of years.

3. Storm event analysis was carried out by calculating the 50th, 95th and 99th percentile of all daily 24-hr rainy days for the Newman station and then developed a daily water balance for each percentile of precipitation.

4. RESULTS

For the proposed treatment wetland, water gains and losses were accounted. Distinct values for each month's flow in a normal year are tabulated in *Table 4* and graphically represented in *Fig. 8*. Flows from MD and agriculture land runoff are referred to as Q_{MD} and Q_{AR}, respectively. After the measurements taken on site, the flow calculated for September 12th and 27th, 2019 is of 8,571 and 8,495 m^3/d, respectively; October 25th, 2019, had 457 m^3/d. Then, for March 13th, 2020, the flow estimated was 639 m^3/d, and June 29th, 2020 had the lowest flow of 369 m^3/d (T*able 2*). These flows were then averaged as high-flow irrigation season, from March to October (8,533 m^3/d), and low-flow non-irrigation season, from November to February (489 m^3/d), to calculate Q_{MD} by month in what we call a 'normal year'.

The value of Q_{MD} will be one of the major and constant contribution to the total inflow year-round except in the months with no irrigation, when water flows from CCID's Main Canal are minimal. The previous inflow is followed by agriculture flow from the surrounding areas during the months with precipitation. However, precipitation into the wetland is highly seasonal and has minimum contribution to water gains. On the other hand, evapotranspiration accounts for the only loss from the wetland as the other parameters were assumed to be negligible (*Fig. 9*). (Note that in Winter 2020 during two relatively small rain events little storm flow was observed in MD. Thus, the assumption that significant storm runoff makes it into MD may not hold. Additional monitoring in winter 2020/21 will help to answer this question.)

Normal Year

The total inflow calculated for a normal year is on average 245,764 m^3/month and the outflow is 220,127 m^3/month (T*able 4*). As expected, the minimum values were observed in February and November, as there is almost no influence of Q_{MD} because it is the time of the year with no irrigation. Besides, there is also low flow from the agricultural land runoff. On the other hand, the peak values are seen in March and April due to agricultural runoff; however, the major contribution is the flow in MD (as shown in *Fig. 8 and 9)* as the irrigation season starts. Nevertheless, due to the variability in MD flow during the year, there is not a clear pattern shown in the graphs. It seems to have higher flow at the beginning and at the end of the irrigation

season and medium flow during summer months, having the lower flow when the irrigation is over, according to the measurements and observations taken in the field.

Moreover, *Fig. 8* shows that almost all year the difference between inflow and outflow is minimum, except during the warmer months when the outflow is smaller as the evapotranspiration increases (*Fig. 9*). Another interesting factor is that during December to February there is slightly higher outflow than inflow as the value of precipitation is bigger than evapotranspiration *(Fig. 8 and 9*). Finally, hydraulic retention time (τ) (*Table 5*) ranged between 5 to 16 days having an average of 9 days, which is inside the optimal time range that will allow good removal of pollutants in the wetland.

Note if the wetland were 10 acres rather than the assumed 30 acres, the hydraulic retention time would decrease by around a third and range from around 1 to 5 days, which is not long enough to get meaningful pollutant removal. However, if the flows to the wetland from MD are lower than assumed for this modeling effort, a smaller wetland could still provide enough residence time to get suitable treatment. Continued monitoring is needed to answer these questions.

Seasonal Time

The seasonal flow was studied for hot and dry summers and wet and cold winter months*.* Typically, summer months have an average outflow of 235,428 m^3/month, which is higher than the average of 198,706 m^3/month during the winter months, and a hydraulic residence time of 7 and 11 days, respectively. A major contributing factor for this seasonality is the evapotranspiration value. The effect of evapotranspiration on outflow is noticeably higher in the warmer summer months, from May to September, with the lowest outflow value in June (*Fig. 10)*. Since, the inflows are not governed exclusively by natural phenomenon of precipitation and evapotranspiration, there is not a typical seasonal pattern. In the winter months two peaks in outflow are seen: one in January, when the agricultural land runoff is the major contributor due to some precipitation, and the second in March, when the irrigation season begins (*Fig. 9 and 10)*.

Dry and wet years

The monthly precipitation percentile outflow values were compared for dry, normal, and wet years*.* For the dry year, with 20th percentile of precipitation, the outflow is 172,094 m^3/month, and for the wet year (80th percentile), the outflow is 305,040 m^3/month (*Table 3* and *Fig. 11);* hydraulic residence time is 17 and 6 days, respectively, which is slightly low for the wet year, but still in the optimal range. The peak outflows were in March, as high as 274,370 and 303,789 m^3/month in wet years

and dry year, respectively; and as low as 210,838 m^3/month during June for the wet year, and 30,775 m^3/month for November during dry years. During summer months, June to August, the values were similar, around 210,220 m^3/month, for the three compared years, dry-normal-wet year, due to the fact that precipitation is not a factor that has a huge influence in the inflow for the proposed wetland (*Fig. 8*).

Normal and extreme storm events

Daily 24-hr precipitation values in winter months for 50th (normal), 95th (extreme), and 99th (very extreme) percentiles are 0.0035 m, 0.02 m, and 0.035 m. Assuming normal year average flow in MD (Q_{MD}), non-irrigation conditions (Q_{AR}) and the previous precipitation values, the events lead to a modeled wetland outflow of 13,041 m^3/d for a normal storm event; 82,672 for m^3/d for an extreme, and 142,062 m^3/d for a very extreme event (*Fig.12)*. This corresponds to the hydraulic residence time of 4, 1, and 0.5 days, respectively, which are a low number of days to ensure good removal of pollutants. However, these events are not as frequent in Central Valley, climate change is contributing to its increment though. In summary, the extreme 24-hour event presents a 534% higher amount of water in the outflow than the normal event and a very extreme event around 989% higher. These values are important when planning the size of the treatment wetland to avoid flooding.

5. CONCLUSIONS

- A goal of this constructed treatment wetland is to provide cleaner water for the City, so identifying the types of water sources and the amount of water that will contribute to the wetland is of utmost importance. These efforts have identified two main sources of water to the proposed treatment wetland, water from Main Canal flowing in MD (Q_{MD}), and stormwater runoff from surrounding agricultural area around MD (Q_{CA}) (*Table 4).*
- It was determined that Q_{GW} would need to be minimized through the design of the wetland with a clay liner on the bottom, as the potential infiltration based on infiltration rates measured in the field is higher than typical inflow from MD. However, it is acknowledged that new infiltration rate measurements are also needed in the wetland area because the value used is from a station near MD and might be higher than infiltration rate across the study site.
- There is a variability in the amount of water in MD that depends on the necessities of CCID users. Due to this variability, there is no a clear seasonal patterns of inflows and outflows. However, calculations show that the wetland would have: (1) higher flow at the beginning and end of the irrigation season (March-April and October) due to high irrigation flows; (2) medium flow during summer months due to high irrigation flows but also high evapotranspiration;

and (3) lowest flows (February and November) when the irrigation time is over and there is slow seepage, according to the measurements and observations taken on the field.

- When the irrigation season is over, the major contributor to the inflow is the agriculture storm runoff as the climate in the region allows precipitation during those months and it is a factor that influence this parameter. Moreover, a major contributing factor for the seasonality is evapotranspiration, being higher during summertime when wetland outflow is relatively low.

- Precipitation directly to the wetland is not a factor that has a huge influence in the inflow for the proposed wetland (*Fig. 9*). However, during the wet year scenario, the outflow is double the amount of outflow during a dry year. Moreover, in a normal year, the outflow is affected during the winter months being slightly higher than the inflow. On the other hand, during the summer months, there is a noticeable difference between the inflow and outflow due to the evapotranspiration which is higher, and the precipitation which is absent.

- The outflow values in the different storm events scenarios showed low residence time, in the range of 0.5 to 4 days, which is not beneficial for good pollutant removal, even with the 30-acres modeled wetland (see pending Memorandum 4). The wetland should have more than 5-day retention time for a high removal. Thus, a smaller wetland might not have water retention time for any pollutant removal during extreme storm events.

- Recent field observations call into question some assumptions and calculations made in this report. First, in Winter 2020 during two relatively small rain events little storm flow was observed in MD. Thus, the assumption that significant storm runoff makes it into MD may not hold. In addition, recent 2020 summer flows were far below the assumed 8,500 m^3/d observed late in the irrigation season in 2019. Thus, there may be less water in MD available to low into the wetland during the summer. We will continue with monthly monitoring of the site to help elucidate these unknows. The City may want to consider installing a flow meter on MD to collect more data.

6. REFERENCES

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7. FIGURES

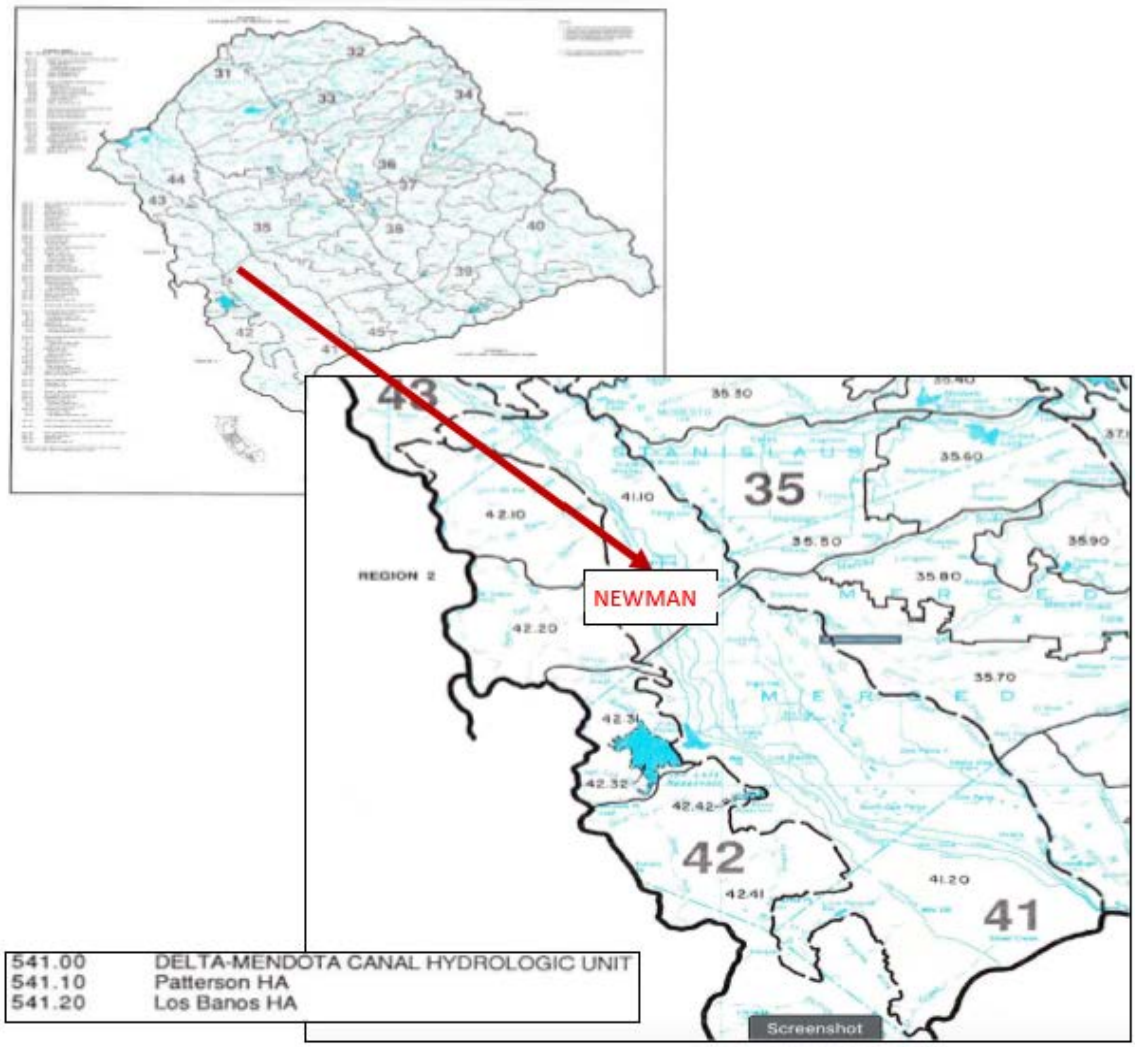

Fig. 1 - San Joaquin Hydrologic Basin Planning Area (top left). Newman is part of Patterson and Los Banos hydrological area subunits in Delta-Mendota Canal Hydrologic Unit, San Joaquin basin (bottom right).

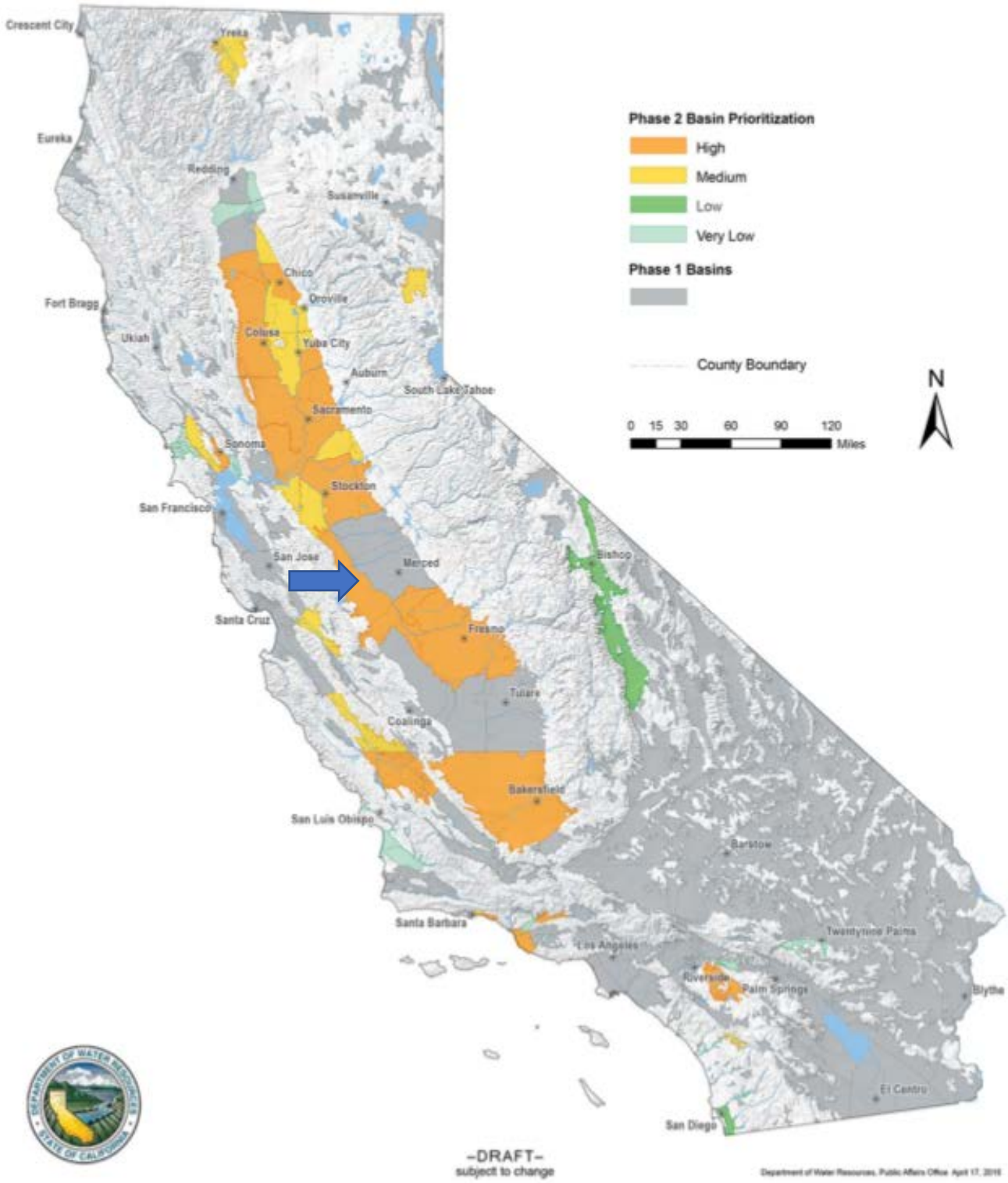

Fig. 2 - Statewide Map of SGMA 2019 Basin Prioritization Results, phase 2 Draft. Project area shown by arrow.

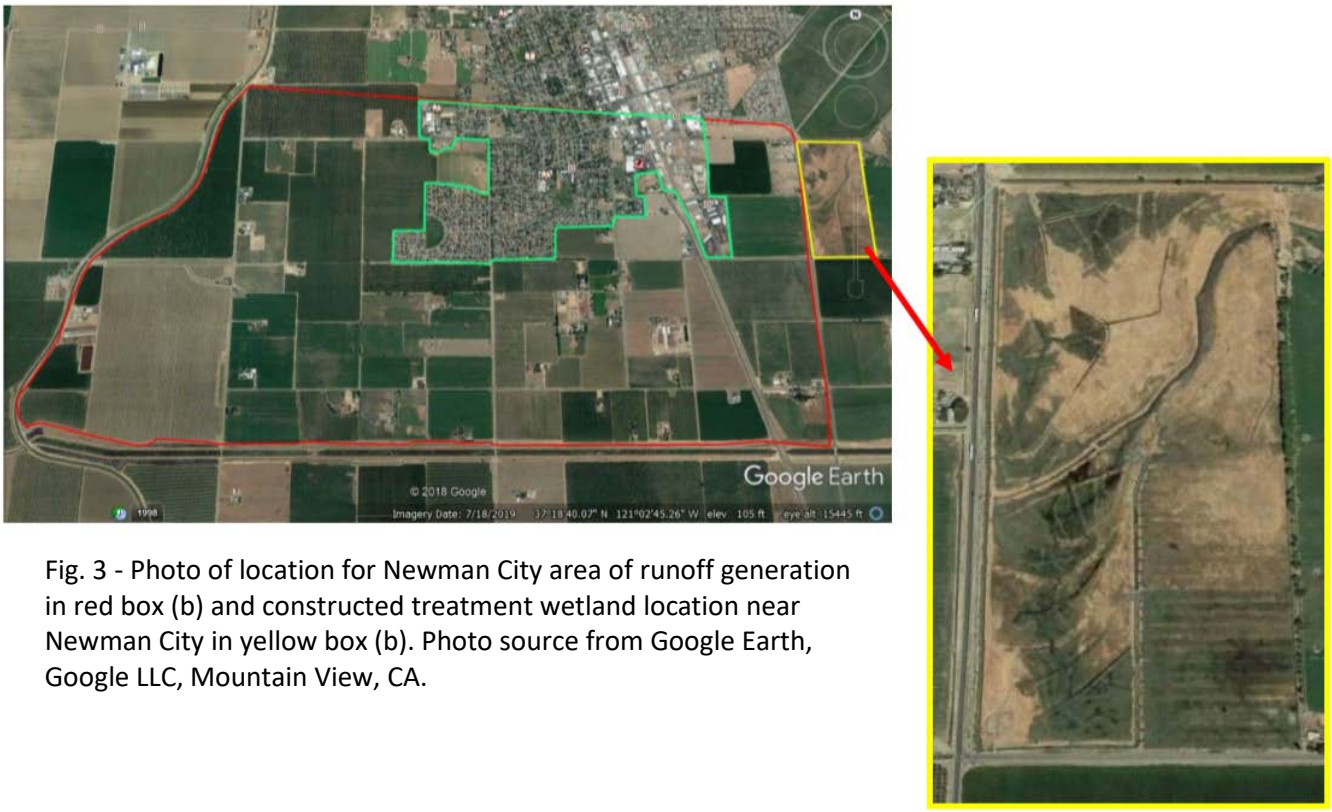

Fig. 3 - Photo of location for Newman City area of runoff generation in red box (b) and constructed treatment wetland location near Newman City in yellow box (b). Photo source from Google Earth, Google LLC, Mountain View, CA.

Fig. 4 - Image of potential layout of final constructed treatment wetland in shape of dragonfly and beetle (bottom left through center), stormwater capture area in shape of butterfly (top left), and recreational area (bottom right). Image source from Redtail Consulting Environment and Community.

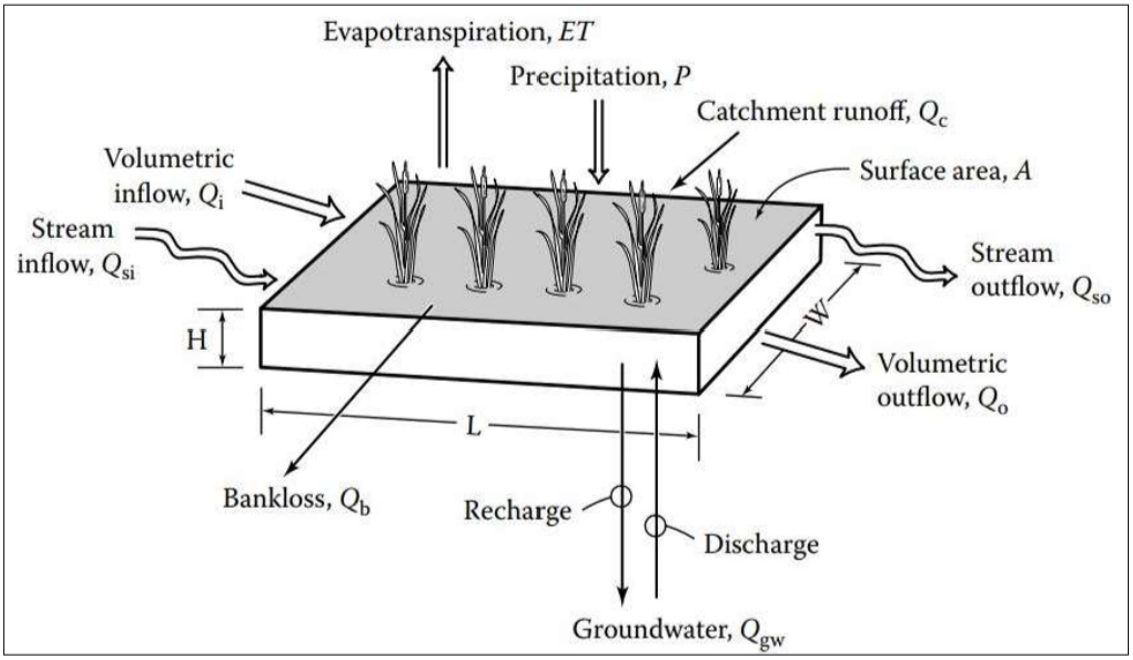

Fig. 5 - Conceptual model of the water losses and gains for calculating water budgets in wetlands (Kadlec and Wallace, 2008).

Fig. 6 - Photos of Miller Ditch and Main Canal on October 25th, 2019. Photos include area between constructed treatment wetland area and Main Canal with mounded banks along ditch with drainpipe (top) and at junction point of Main Canal and Miller Ditch (bottom) with assumed control weir (bottom right) that control flows.

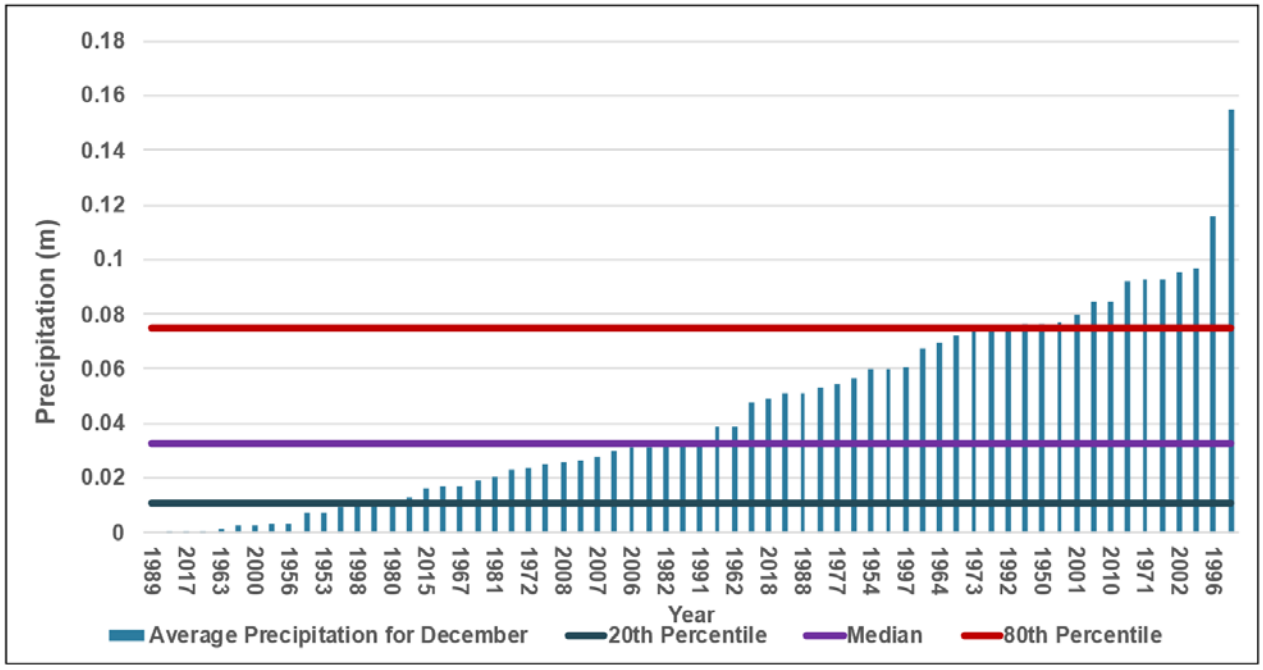

Fig. 7 – Example graph of precipitation in December from 1950 through 2018 (excluding missing data) from NOAA at Newman, CA. Calculated 20th, 50th (i.e., median), and 80th percentiles shown.

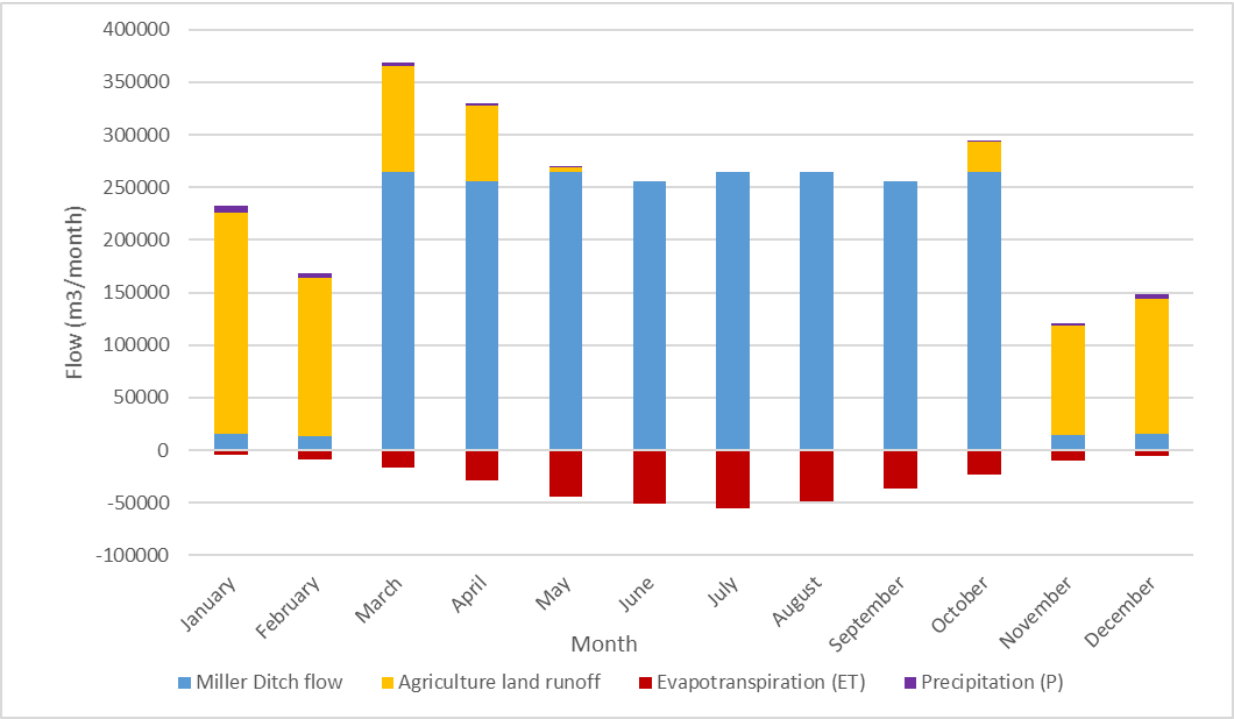

Fig. 8 – Monthly gains and losses in 30-acre treatment wetland.

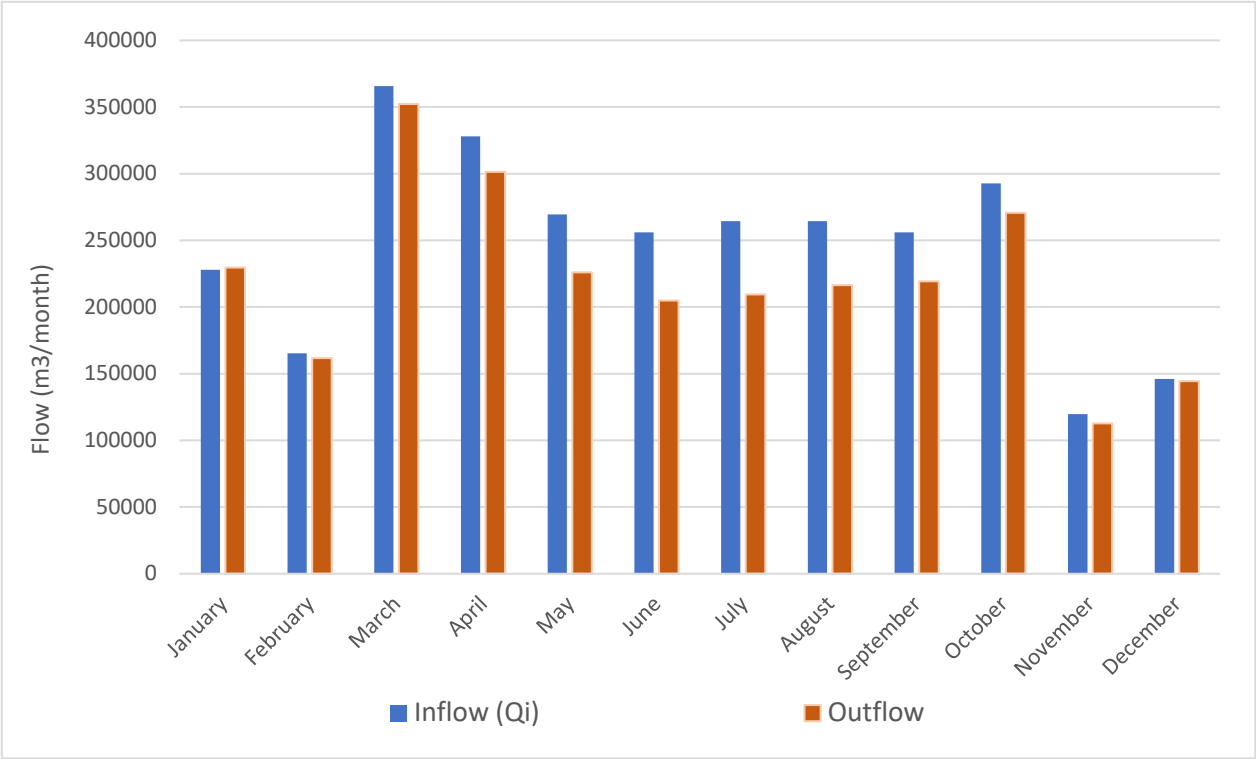

Fig. 9 – Monthly total inflow and outflow in normal year.

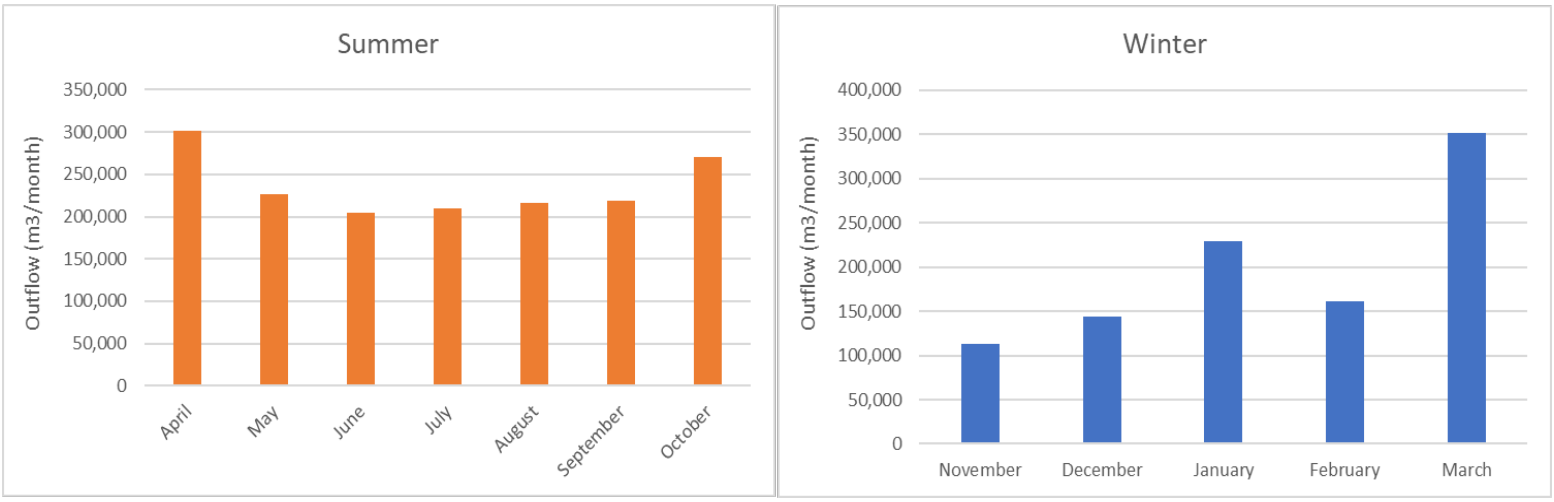

Fig.10 – Summer vs. winter outflows comparison in a normal year.

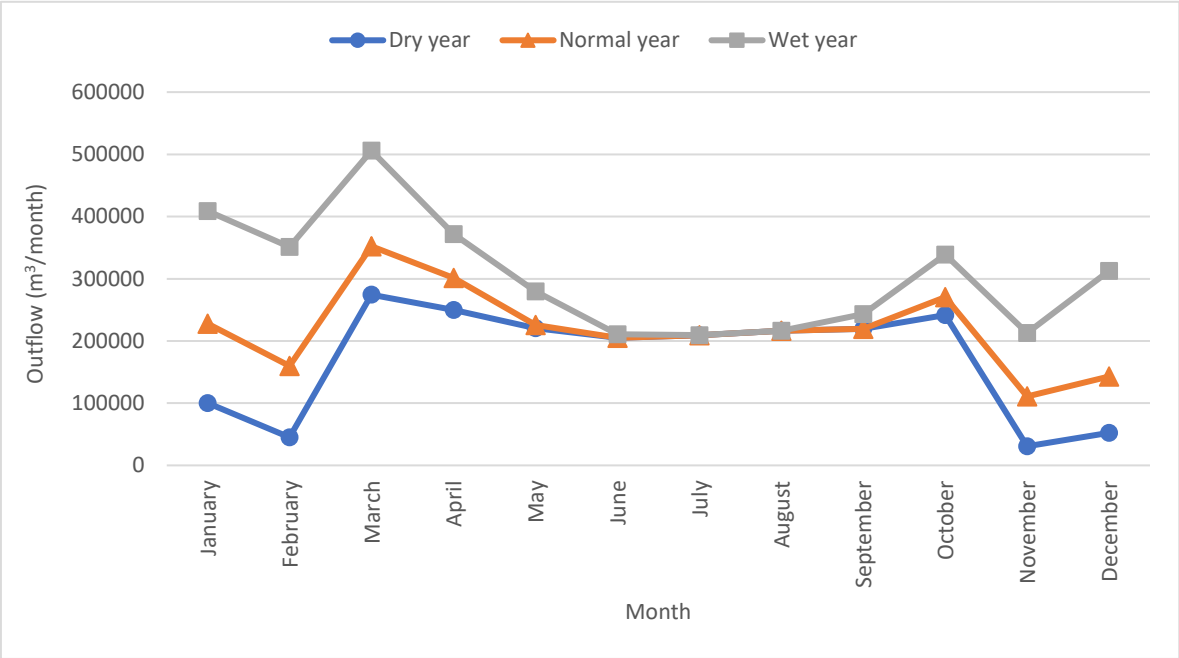

Fig.11 – Wet, Normal and Dry year outflow for proposed wetland in Newman City.

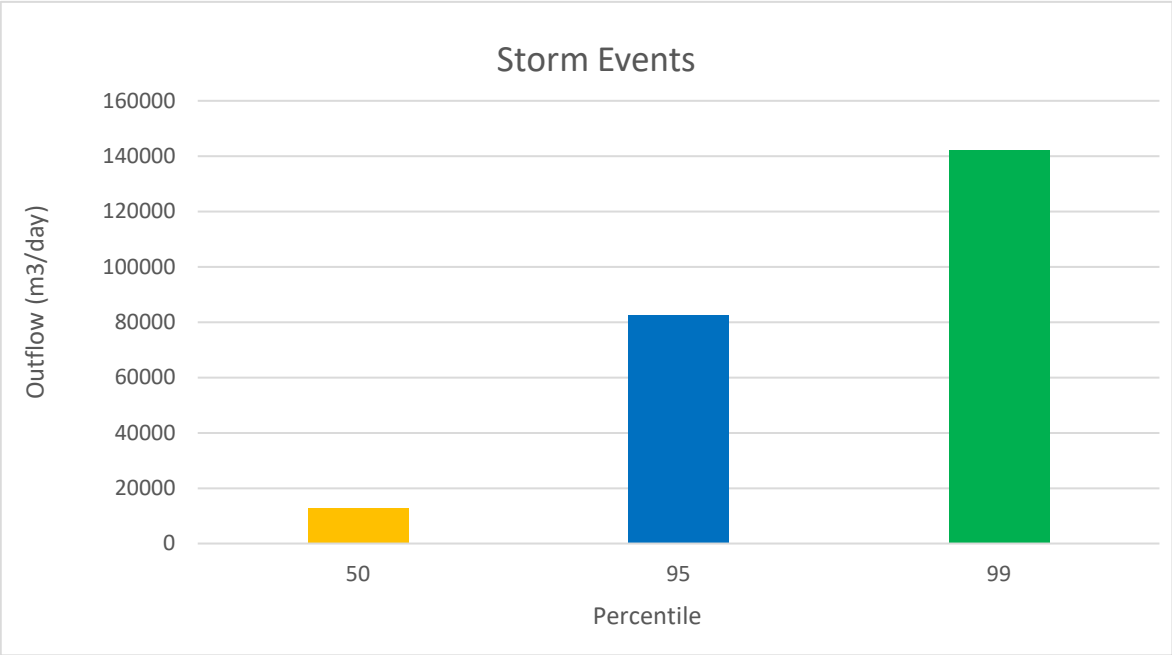

Fig. 12 – Outflows associated with 24-hour storm events: normal (median -50th percentile- storm), extreme (95th percentile), and very extreme (99th percentile) at the proposed wetland in Newman City.

8. TABLES

Basin Number	Basin/Sub-basin Name	Area (ac)	Area (mi^2)	Priority
5-022.07	Delta-Mendota	764,964.86	1,195.26	High

Table 1. Statewide SGMA 2019 Basin Prioritization Results, Phase 2 Draft information for the basin with Newman, CA.

STATION MD1A					
	09/12/19	09/27/19	10/25/19	03/13/20	06/29/20
Distance (m)	3.5	9.14	0.3	2.13	
Area (m^2)	0.45	0.88	0.03	0.19	
Volume (m^3)					0.019
Time (s)	14.4	74	60	140	20
Velocity average (m/s)	0.22	0.11	0.17	0.04	
Ratio (weir and bucket diameter)					5
Flow rate (m^3/day)	8,571	8,495	457	639	406
Average flow rate (m3/day)	**3714**				

Table 2. Table of velocity, canal dimension measurements, and flow rate calculations in Miller Ditch. A coefficient of 0.9 was used to convert measured velocity to average velocity.

Month	Precipitation 20% (m/month)	Precipitation Normal year (m/month)	Precipitation 80% (m/month)	Evapotranspiration (m/month)
January	0.022	0.054	0.099	0.040
February	0.010	0.038	0.086	0.069
March	0.007	0.026	0.064	0.138
April	0.006	0.018	0.036	0.237
May	0	0.001	0.015	0.360
June	0	0	0.001	0.421
July	0	0	0	0.453
August	0	0	0	0.397
September	0	0	0.006	0.301
October	0	0.007	0.024	0.190
November	0.007	0.026	0.052	0.085
December	0.011	0.033	0.075	0.046
Average	0.005	0.017	0.038	0.228

Table 3. 20th, 50th (i.e., median), and 80th percentile calculations of monthly rainfall from NOAA station at Newman, CA from 1950 to 2018 used for the water balance analysis. Note evapotranspiration was assumed to be the same in all years.

Month	Miller Ditch flow (Q_{MD}) (m3/month)	Agriculture land runoff (Q_{AR}) (m3/month)	Total inflow (Q_i) (m3/month)	Precipitation into wetland (P) (m3/month)	Evapotranspiration from wetland (ET) (m3/month)	Outflow (Qo) (m3/month)
January	15,144	211,042	226,186	6,553	4,841	227,898
February	13,679	149,964	163,643	4,656	8,357	159,942
March	264,522	101,300	365,822	3,145	16,775	352,192
April	255,989	72,003	327,991	2,236	28,802	301,425
May	264,522	4,966	269,487	154	43,727	225,915
June	255,989	0	255,989	0	51,128	204,861
July	264,522	0	264,522	0	55,044	209,477
August	264,522	0	264,522	0	48,198	216,323
September	255,989	0	255,989	0	36,604	219,385
October	264,522	28,304	292,826	879	23,097	270,608
November	14,656	103,287	117,942	3,207	10,300	110,850
December	15,144	129,108	144,252	4,009	5,612	142,649
Annual average	**179,100**	**66,665**	**245,764**	**2,070**	**27,707**	**220,127**

Table 4. Calculated water balance variables for the normal year scenario, using 50th percentile (i.e., median) values for precipitation, for proposed treatment wetland near Newman, CA.

Month	Hydraulic retention time (τ) normal year (day)
January	8
February	11
March	5
April	6
May	8
June	8
July	8
August	8
September	8
October	7
November	16
December	13
Annual average	**9**

Table 5. Hydraulic retention time (τ) using 50th percentile (i.e., median) values for precipitation for proposed treatment wetland near Newman, CA.

UNIVERSITY OF CALIFORNIA

MERCED

NEWMAN CONSTRUCTED TREATMENT WETLAND

WATER QUALITY REPORT

(Memorandum 3)

June 2020

DRAFT

Prepared by

Naivy Dennise Rodal Morales, Ph.D. Student, Environmental Systems Graduate Group

Dr. Marc Beutel, Associate Professor, Civil and Environmental Engineering, Environmental Systems Graduate Group

NEWMAN CONSTRUCTED TREATMENT WETLAND

WATER QUALITY REPORT

1. SUMMARY

This report (Memorandum 3) covers the water quality information from Miller Ditch (MD) in Newman City related to the potential future construction of a treatment wetland in the southwest corner of the study site to treat MD flow (Fig. 1). This wetland is complementary but different from the Newman Environmental Wetland System (NEWS) being implemented in the northwest of the study site to treat urban runoff and agricultural drainage from north of the City. The investigation consists of two assessments, the sampling events done at the study site in MD since September 2019 and the general water chemistry of the area represented by Newman Wasteway nearby and downstream of the MD discharge. The report includes a comparison between these two water quality data sources. The data assessed in this report represent a background concentration of pollutants and incoming water quality to any future treatment wetland. These data will be used in our treatment report (Memorandum 4) to model expected pollutant removal and salinity concentrations of a full-scale construction and operation of the wetland to treat MD flow. Data can also be used to inform the NEWS project.

The sampling events at MD started in September to October 2019 (dry weather) and continued in March to April 2020 (wet weather), where only two small rain events occurred. Water samples were measured for nutrients including ammonia, nitrate, total phosphorus (TP) and dissolved phosphate (PO4); for sediment in the water via total suspended solids (TSS); and for salinity in the water via electrical conductivity (EC). Flow in MD was also roughly estimated by visual inspection. The results showed low concentrations of nutrients and salinity in September 2019 when MD flow was high (TP ~0.35 mg-P/L, PO4 ~0.2 mg-P/L, nitrate ~1.7 mg-N/L, EC~340 µS/cm), likely a result of flow-through of relatively high quality imported irrigation water. High concentrations of nitrate and EC, but lower concentrations of P, were observed in October 2019 when MD flow was low (TP ~0.1 mg-P/L, PO4 ~0.1 mg-P/L, nitrate ~8.4 mg-N/L, EC~1300 µS/cm). The high salinity and nitrate suggest that MD was dominated by shallow groundwater inputs in October after irrigation flows were turned off for the season.

During low-flow dry weather sampling in March 2020, nutrient and conductivity levels in MD were low and ammonia was detectable at low levels (TP ~0.1 mg-P/L, PO4 ~0.04 mg-P/L, nitrate ~2.0 mg-N/L, ammonia ~0.1 mg-N/L, EC~ 800 µS/cm). During low-flow wet conditions in March 2020 at station MD2A associated with stormwater from the City coming into MD, all the compounds presented low concentrations, except for TSS and ammonia, likely resulting from decay of organic matter (OM) in City runoff (TP ~0.4 mg-P/L, PO4 ~0.2 mg-P/L, nitrate ~0.6 mg-N/L, ammonia ~0.7 mg-N/L, EC ~200 µS/cm, TSS

~200 mg/L). Wet weather did not yield high flows in MD, suggesting it does not capture substantial stormwater.

Monitoring suggests three regimes of water quality and flow in MD. First, during the summer irrigation season (e.g., September 2019 sampling event), flow is relatively high in MD and is dominated by unused imported water low in salinity and nitrate. Second, during the dry fall after irrigation flows are discontinued (e.g., October 2019 sampling event) flow in MD is low and dominated by shallow groundwater inputs high in salinity and nitrate, but low in phosphorus. Third, during the winter MD flows are low to moderate and salinity is somewhat elevated suggesting a mixture of shallow groundwater and modest fresher rainfall-related inputs. Further monitoring is needed to assess this proposed flow/water quality conceptual model, which of course would be impacted by annual variability in weather conditions (e.g., wet year vs dry year).

The comparison between MD water quality data and Newman Wasteway data collected by the Westside San Joaquin Watershed Coalition showed that the two sties had similar water quality. Water quality in Newman Wasteway was typically: TP ~0.3 mg-P/L, PO4 ~0.1 mg-P/L, nitrate ~1.0 mg-N/L, and ammonia ~0.3 mg-N/L. TSS measured at MD (~80 mg/L) was generally higher than levels measured in the Newman Wasteway (~50 mg/L). Finally, a range of pesticides were measure in a sampled collected as part of this study in MD in September 2019, and it was found no detectable pesticides.

2. INTRODUCTION

Newman City is a small agricultural community with a population of approximately 11,000 people (US Census Bureau, 2019) located in Stanislaus County, on the west side of California's Central Valley, one of the most productive agricultural regions in the world. In this area, increasing population and agricultural activity is projected to strain scarce water resources; thus, water reuse and recycling is highly important for the region.

The City recently purchased around 100 acres of land to its southeast with the vision of developing a treatment wetland system. The system would treat urban stormwater and agricultural runoff, while providing public recreational and educational opportunities related to wetland ecology and sustainable water management. In addition, the City might ultimately be able to harvest the relatively low-salinity water to dilute high-salinity treated wastewater used to irrigate crops and recharge groundwater. The City is now developing an application to the State of California to implement the Newman Environmental Wetlands System (NEWS). The 21-acre system would capture and treat stormwater runoff from the City as well as agricultural runoff from north of the City (*Fig. 1).* The City is also working with the State to develop around 10 acres of restored native habitat in the central-east section of the study site. In addition, an educational community area would be developed in the south-east section of the area (*Fig. 1*).

This study focuses on a third potential treatment wetland. This treatment wetland would be constructed on the southwest corner of the study site, adjacent to Canal School Rd and Baraza Rd (*Fig. 1*). The size of the treatment wetland is not yet formally determined and could range in size from around 20-40 acres. The wetland would treat receiving water from the south section of MD which includes water delivery flow-through, agricultural runoff and precipitation-related agricultural stormwater. As noted above, this low-salinity water could ultimately be used to dilute treated wastewater used for land application and groundwater recharge. The water delivered by MD is imported via state and federally managed canals from the Sacramento-San Joaquin Delta to irrigate agricultural crops. Water imported to the region also brings a large quantity of salt into the San Joaquin Valley. A lack of export can concentrate salinity in the Central Valley's surface and groundwater. In addition, intensive agriculture in the region has led to high nitrate levels in surface and groundwater, in some cases exceeding the maximum contamination level for drinking water (10 mg-N/L) regulated for the California Regional Water Quality Control Board (*2018*). Farmers and agricultural operations are also concerned with salt concentrations in the water because high salt concentrations retard plant growth.

The aim of this report is to present water quality information from MD, the source water for the southeast treatment wetland that will potentially be built by Newman City. Moreover, we present a comparison between the water quality measured in MD and available recent information from Newman Wasteway, a nearby drainage canal. Water quality samples have been collected in the prospected wetland in different locations along MD since September 2019 for nutrients, salinity, and pesticides. This information will be used in our treatment report (Memorandum 4) to model the effectiveness of pollutant removal of nutrients in the treatment wetland.

3. METHODS

To have a background water quality dataset of the incoming concentrations of compounds of interest to any future treatment wetland, water samples were taken starting in September 2019. Samples were analyzed at UC Merced's Environmental Analytical Laboratory (EAL) for ammonia, nitrate, total phosphorus (TP), dissolved phosphate (PO4), and total suspended solids (TSS) for sampling events 1-3 using the standard methods outlined in *Table 1*. Due to the "covid" situation and the shutdown of EAL, samples for events 4-6 were sent to a professional lab, Caltest Analytical Laboratory, and methods are outlined in the lab's analytical report included in Appendix A. Conductivity was also measured in all samples for events 1-6 using a calibrated HACH meter and conductivity probe. Water samples have not yet been analyzed for event 7, but we did start monitoring for an expanded set of field water quality parameters during event 7 (dissolved oxygen, conductivity, temperature, and pH) using calibrated HACH meter and probes (*Fig. 3d;* see *Table 4* in Results and Discussion).

Samples were collected in 500 ml plastic bottles cleaned with weak hydrochloric acid. The dissolved nutrient samples (ammonia, nitrate, phosphate) were 0.45 µm filtered and frozen. TP samples were frozen unfiltered. TSS was measured on fresh samples by filtering a known volume through a glass fiber filter and measuring weight of filter before and after solids collection (after air drying for one day). Finally, a pesticide sample collected on September 27, 2019 in MD was sent to the Environmental Micro Analysis Inc. laboratory for assessment of pyrethroid, organophosphates and organochlorines. Methods and results are included in the lab's report in Appendix B.

ANALYSIS	PRESERVATION METHOD	ANALYTICAL METHOD	METHOD DETECTION LIMIT
Ammonia	0.45 µm filtered and frozen	Phenate colorimetric	20 µg-N/L
Nitrate	0.45 µm filtered and frozen	NED dihydrochloride colorimetric	50 µg-N/L
Dissolved Phosphate	0.45 µm filtered and frozen	Ascorbic acid colorimetric	20 µg-P/L
Total Phosphorus	Frozen	Persulfate digestion; Ascorbic acid colorimetric	20 µg-P/L

Table 1. Methods used for the measurement of nutrients in Miller Ditch, Newman City, California

Monitoring events summary

Monitoring stations on MD are tabulated below in *Table 2* and are shown in *Fig. 2.* Sites with the MD1 designation include stations upstream of the City stormwater pump. This station pumps City stormwater and agricultural drainage from north of the city to MD at the northwest corner of the study area. On the other hand, stations with the MD2 designation are located downstream of the same pump.

Sample site	Description
MD1A	Miller Ditch at southwest corner of site upstream of stormwater pump station input
MD1B	Miller Ditch at northwest corner of site upstream of stormwater pump station input
MD2A	Stormwater pump station input to Miller Ditch
MD2B	Miller Ditch downstream of stormwater input

Table 2. Description of the sampling points shown in Fig. 1 and Table 5

To date a total of seven monitoring events have been performed and are summarized below *(Table 3)*:

DATE	STATION	NOTES
09/12/19	**MD1A**	High sediment in the water in MD1A (TSS)
	MD2B	
09/27/19	**MD1A**	High flow measurement estimate
	MD2B	
10/25/19	**MD1A**	
	MD2A	High salinity and nitrate and TSS
03/13/20	**MD1B**	Low flow measurements estimate
	MD2B	
03/16/20	**MD1B**	Some rain. Pump station was discharging every ~15 minutes
	MD2A*	
04/06/20	**MD1B**	Some rain. pump station was discharging every ~5 minutes. Water appear to have more sediment than usual
	MD2A	
	MD2A*	
5/29/20	**MD1A**	Emergent vegetation and algae in MD. The water looked clear (clean). Flow from pump station 5 min after we arrived, but did not turn on again
	MD2A	
	MD2B	

Table 3. Summary of the sampling events at Miller Ditch, Newman City, CA

- Events 1 & 2: September 12th and 27th, 2019

Samples were collected in stations MD1A and MD2B. These monitoring events were for reconnaissance purposes and to start developing some sample stations. No rain events occurred near that time; however, high flow was seen in MD (*Fig. 4a and 5a)*. The water velocity was estimated using a small floating object and measuring the distance and time traveled *(Fig. 3c*). For the flow estimation, the velocity was multiplied by the area of water occupied in the canal. When filtering the water, in September 12th, the color of the filters had an intense brown showing elevated concentration of suspended solids (TSS) in the water for MD1A compared to MD2B (*Fig. 3b, Table 5*). Samples had relatively low salinity measured as conductivity.

- Event 3: October 25th, 2019

On the contrary to the previous events, the flow estimated in MD resulted in a low flow value which velocity was measured with a velocity sensor *(Fig. 4b).* In this case, the samples were collected in the stations MD1A and MD2A. Samples had high nitrate and salinity values, which differs from the previous measurements, and MD2A had high TSS concentration (*Table 5*).

- Event 4: March 13th, 2020

For this event, samples were collected under dry weather before a small storm arrived to assess winter pre-storm conditions. Samples were collected at stations MD1B and MD2B where the flow was low as seen in the previous sampling date (*Fig. 4c*). The velocity was measured with a small floating bottle filled with water and multiplied by the area where the water passes through the Ditch for the flow estimation (*Fig. 3b and Table 5)*.

- Event 5: March 16th, 2020

The samples were collected at stations MD1B and MD2A*. The date is close to the previous sample event because some rain occurred around this period. Even though, the flow was still low in MD upstream of pump station. This time, the activity of the pump station was noticeable every 15 minutes showing gray outcoming water with some septic odor (*Fig. 3c and Table 5)*. Note that MD2A* is designated as a sample collected near MD2A station where the pump station discharge is mixed, but technically not a sample of pumped water in pipe discharge.

- Event 6: April 06th, 2020

Some rain was seen around this period, but the flow in Miller Ditch was still low (*Fig. 4d).* The samples were collected from stations MD1B, MD2A and MD2A* and appeared to have more sediment in it upon filtering (*Fig. 3b*) compared to the previous samples collected. The pump station was discharging more often, every 5 minutes, presenting a septic odor and gray color (*Table 5)*.

- Event 7: May 29th, 2020

Little rain was seen during the month of May, and low flow conditions allowed the formation of a submerged wetland conditions to develop in MD at station MD1B. The water at MD1B was clear and clean and, on the surface, green algae was seen, as well as emergent vegetation. Due to this dense vegetation, flow was not able to be measured. Moreover, a water sample was taken at station MD2A before the pump station shut down and never went on again during our time sampling (~30 minutes). This pumped water presumably was irrigation runoff from area north of the City. Samples and field measurements were also taken at stations MD1A and MD1B (*Table 4 and 5)*. Note water quality analyses have not yet been performed for this monitoring event.

4. RESULTS AND DISCUSSION

MD1A	MD1B	MD2B
pH: 7.21 **T:** 24.8°C **Conductivity:** 714 µS/cm **DO:** 5.3 mg/L (64.5% sat)	**pH:** 6.99 **T:** 24.6°C **Conductivity:** 856 µS/cm **DO:** 3.27 mg/L (54.3% sat)	**pH:** 7.66 **T:** 24°C **Conductivity:** 1648 µS/cm **DO:** 7.6 mg/L (90.7% sat)

Table 4. Field water quality data during May 29th, 2020

Nitrate

The excessive use of nitrogen fertilizer in agriculture in the Central Valley has led to groundwater infiltration and contamination with nitrate; consequently, 250,000 people in the region are at risk of hazardous exposure to nitrates, and 80% of the population is projected to be impacted by nitrates by 2050, given current regulatory trends and fertilizer application rates *(Harter et al., 2012).* The most vulnerable communities are agriculture-

WATER QUALITY								
	09/12/19	**09/27/19**	**10/25/19**	**03/13/20**	**03/16/20**	**04/06/20**		**05/29/20**
Flow at MD1B	high	high	low	low	low	low		medium-low
Dry vs Wet	dry	dry	dry	dry	wet	wet		dry
MD1A								
Total P (mg-P/L)	0.46	0.25	0.06					
PO4 (mg-P/L)	0.22	0.17	0.03					
NH3 (mg-N/L)	0	0	0					
NO3 (mg-N/L)	3.25	0.64	8.35					
Conductivity (µS/cm)	313	447	1239					714
TSS (mg/L)	105	69	87					
MD1B								
Total P (mg-P/L)				0.07	0.10	0.41		
PO4 (mg-P/L)				0.02	0.03	0.28		
NH3 (mg-N/L)				0.04	0.03	0.19		
NO3 (mg-N/L)				1.7	0.28	0.57		
Conductivity (µS/cm)				762	657	783		856
TSS (mg/L)				18	13	27		
			MD2A		**MD2A***	**MD2A**	**MD2A***	
Total P (mg-P/L)			0.17		0.27	0.41	0.54	
PO4 (mg-P/L)			0.14		0.17	0.15	0.13	
NH3 (mg-N/L)			0		0.43	0.69	0.62	
NO3 (mg-N/L)			0.95		1.0	0.56	1.6	
Conductivity (µS/cm)			1323		145	178	190	
TSS (mg/L)			218		38	143	241	
MD2B								
Total P (mg-P/L)	0.36	0.34		0.11				
PO4 (mg-P/L)	0.25	0.21		0.053				
NH3 (mg-N/L)	0	0		0.22				
NO3 (mg-N/L)	1.85	1.03		2.5				
Conductivity (µS/cm)	319	267		860				1648
TSS (mg/L)	31	48		12				

Table 5. Summary of MD water chemistry in Newman City, CA

dependent, low-income townships that relay on groundwater for potable use, such as the City of Newman.

The concentrations of nitrate found in MD at station MD1A ranged from 0.64 to 3.25 mg-N/L during high-flow conditions. However, nitrate from October 25th presented the highest concentration during low flow of 8.35 mg-N/L, probably attributed to groundwater infiltration into MD during times of low flow after the active fertilization agricultural season. Sites MD1B and MD2A presented almost no variations, with nitrate concentrations of around 0.3 to 1.6 mg-N/L, during the multiple days of sampling with low flow wet conditions (*Table 5*). In the same way, low-flow dry conditions present nitrate concentration between 1.5 and 2.5 mg-N/L (at MD1B and MD2B). Nevertheless, waters with nitrate concentrations less than 10 mg-N/L are generally acceptable for human consumption and groundwater use (*Kadlec and Wallace, 2009*), thus nitrate level in MD water are not extreme. However, removal of nitrate in a treatment wetland will ultimately benefit the regional environment by lowering the potential for nitrate to stimulate eutrophication in surface waters and to contaminate groundwater.

Treatment wetlands can generate anoxic conditions where anaerobic denitrifying microbes can transform nitrate into harmless gaseous N_2, a process called denitrification. These reduced conditions can be enhanced by restricting aeration into the water and sediment, which can be accomplished by increasing the density of emergent macrophytes or by increasing the depth of the wetland. Emergent macrophytes suppress the amount of air exchange at the wetland waster surface. Emergent plants also block light from the water column, which impact the ability of submerged aquatic vegetation (SAV) to perfrom photosynthesis and produce oxygen. Both reduced aeration and reduced photosynthetic activity of SAV lowers the dissolved oxygen (DO) concentration in the water, conditions needed for denitrification. Alternatively, oxygen concentrations are lower deeper in the water column, hence, increasing the depth of the wetland can also provide the reduced conditions. However, emergent macrophytes will not survive if the water is too deep, and thus utilization of these methods must be optimized because emergent macrophytes also provide a physical substrate for development of microbial biofilms like denitrifying bacteria (*Kadlec and Wallace, 2009)*.

Given that nitrate removal is dominated by microbial action, it is necessary to create ideal conditions for denitrifying microbe's establishment and growth. Microbes are sensitive to temperature and pH. At higher temperatures, the activity of denitrifying bacteria increases, leading to higher removal rates during the warm summertime. Additionally, denitrifying bacteria require a slightly basic medium (pH range of 7-7.5 is ideal), though, they can tolerate a pH range of 6-9 (*Kadlec and Wallace, 2009)*. It is therefore necessary that the pH of the incoming water does not exceed the tolerances of denitrifying bacteria as it could result in a significant change in microbial community

composition and inhibition of denitrification. pH values of 7 recently measured in MD are in the ideal range to support microbial denitrification (*Table 4*).

Ammonia

Ammonia is an inorganic, reduced form of nitrogen that can enter wetlands from agricultural applications of synthetic fertilizers or naturally via breakdown of organic matter. Ammonia can exist in water in its unionized (NH_3) and ionized form (NH_4^+) depending on the temperature and pH of the water. pH higher than 9 and high temperature (30°C) favor ammonium formation, which can be toxic to aquatic biota in concentration higher than around 0.02 mg-N/L. Thus, a neutral pH (and 25°C) favors non-toxic NH_4^+ formation, which vegetation and microbes use to grow (*Kadlec and Wallace, 2009)*.

The results of MD showed ammonia concentration was below 0.02 mg-N/L, the method detection limit, during high-flow dry conditions. Thus ammonia appears to be a compound of no concern in the wetland. However, when the conditions changed to low-dry flow, ammonia began to be detectable in the water, in MD1B with 0.04 mg-N/L and in MD2B with 0.22 mg-N/L. Then, during low-flow wet conditions ammonia was observed at MD2A (and MD2A*) from 0.43 to 0.69 mg-N/L, while MD1B concentrations fluctuated between 0.03 and 0.19 mg-N/L *(Table 5).* Comparing the results with typical agricultural waters, ammonia concentration in MD is between the typically observed values of 0.33-0.48 mg/L, except in MD2A which values are slightly higher *(Fig.6).*

The principal mechanism that lowers the concentration of ammonia in wetlands is nitrification, which is the two-step transformation of ammonia to nitrogen oxides, first to nitrite followed by a subsequence reaction that converts it to nitrate. This process is performed by two different types of bacteria, and energy released from the reaction is used for their cell synthesis and can only proceed when oxygen is present in the water. Thus, the nitrification rate is controlled by the flux of dissolved oxygen into the system. Therefore, the effect vegetation plays in the wetland is essential; having areas that allow reaeration and submerged aquatic vegetation is necessary for the O_2 production that is directly supplied to the water. Vegetation also provides surfaces where nitrifying bacteria can reside. Moreover, an interesting effect nitrification has in the water is that it lowers alkalinity and pH in the water; thus, the optimal pH range for an effective nitrification is about 7-9 (*Kadlec and Wallace, 2009)*. An additional sink for ammonia in wetlands is uptake into wetland plants, as well as bacteria and algae. Nitrogen is a key plant nutrient needed for growth. When a plant dies, most of its nitrogen will decay and be related as ammonia back to the wetland. But some of it will be buried in plant biomass in the sediment along with its nitrogen, resulting in the permanent loss of the nitrogen from the system.

In wetland systems highly loaded with ammonia (> 120 g-N/m^2·yr), the net removal of ammonia is controlled by the nitrification reaction; these systems are termed microbial wetlands. In this scenario, water temperature has a large influence in the microbe's performance of the reaction. During warmer months, microbial activity is higher, allowing for better removal compared to the cold season. On the contrary, when the system is lightly loaded, plant uptake and burial will dominate ammonia removal, because the load does not exceed the growth requirements of plants; these wetlands are called agronomic wetlands (*Kadlec and Wallace, 2009)*. Based on our water quality monitoring and the low observed ammonia levels, any future treatment wetland treating MD flow would be categorized as an agronomic wetland with regards to ammonia processing, and the trace amounts of ammonia will be removed by the wetland.

Phosphorus

Phosphorus, along with nitrogen, is another necessary nutrient for plant growth. Like nitrogen, phosphorus pollution is linked to runoff from agricultural fertilizers and too much phosphorus can cause eutrophication of rivers and lakes. Unlike nitrate and ammonia, phosphate tends to sorb to sediment particles, thus processes like erosion and sediment mobilization can enhance phosphorus pollution to surface waters. Thus, collecting or trapping sediment can be an effective means to lower phosphorus pollution. Phosphorus is generally measured in two forms: TP and dissolved phosphates. TP includes phosphates dissolved in the water, phosphate sorbed to particulates, phosphorus in sediment minerals, and organic phosphorus particulates such as small pieces of plant matter. Dissolved phosphates are phosphate molecules dissolved in the water which are highly bioavailable and can directly stimulate plant growth.

The TP concentrations found in MD water samples ranged from around 0.06 to 0.46 mg-P/L during high-dry flow in MD1A. However, under low-dry conditions the concentration decreased to ~0.06 mg-P/L at MD1A and MD1B; although, MD2B was slightly higher with 0.11 mg-P/L. Then, during low-flow wet conditions, TP concentration increased to 0.1 to 0.41 mg-P/L in MD1B and MD2A. MD2A* had the higher concentration of 0.54 mg-P/L under the same conditions (*Table 5).* Phosphate (PO4) concentrations vary from 0.17 to 0.25 mg-P/L at site MD1A and MD2B under high flow dry conditions. Low dry conditions in MD1A and MD1B have low concentrations of ~0.025 mg-P/L and 0.053 mg-P/L at MD2B, while MD2A has the higher values of 0.14 mg-P/L. MD1B has a concentration of 0.03 to 0.28 mg-P/L under low flow wet conditions (from March to April). Finally, MD2A and MD2A* shows a concentration of ~0.15 mg-P/L during the same conditions.

In general, dissolved phosphates accounted for around half of the TP in samples. Hence, flows in MD and from the City pump station include both particulate phosphorus and highly bioavailable dissolved phosphate. Typical values for TP and phosphate in agricultural runoff are 0.34 and 0.13-0.27 mg-P/L, respectively. Thus, concentrations

measured in MD are close in range for TP and slightly smaller for phosphate when compared to typical agricultural runoff (*Kadlec and Wallace, 2009)* (*Fig.6*).

Phosphorus is removed from water in treatment wetlands by plants uptake and burial, the main long-term sink, and sorption onto sediment, a short sink since the sediment has a finite sorption capacity. Phosphorus removal is basically controlled by the plants growing season, having two peaks on its removal, one in spring when plants start growing dramatically, and the second one in fall when roots perform a last uptake of phosphorus to store it for the winter time (*Kadlec and Wallace, 2009)*. Because phosphorus removal is treatment wetlands in agronomic (a slow seasonal process) rather than microbial (a fast temperature-dependent process), a large wetland is generally needed to reduce significant amounts of phosphorus (*Kadlec and Wallace, 2009)*. On the other hand, during the first two years after the development of a new treatment wetland, phosphorus (and nitrogen) removal is generally high, since the new plants are growing and using more nutrients than a mature wetland would need (*Kadlec and Wallace, 2009*).

Conductivity

In the Central Valley, the key source of salinity in surface water is from pumping high-salinity groundwater into surface channels. Groundwater aquifers are high in salinity due to historical saltwater intrusions and intense agricultural water application that leaches salts into the soil to the water table *(State Water Resources Control Board, 2016).* Electrical conductivity was measured at MD to assess for salinity because it measures the dissolved ions (charged particles) that can pass a current through the water, proportional to the amount of dissolved salts in the water. Typical freshwater conductivity values are < 500 µS/cm, which is considered a low salinity value. Plants and crops start suffering the consequences of high salinity with values higher than 1200 µS/cm, and potable water is accepted under 900 µS/cm (*SWRCB, 2016).*

Salinity throughout MD is similar to nitrate behavior; during high-flow dry months values are the lowest. Conductivity (EC) increased from 313 µS/cm (in September 9th, 2019) to 1239 µS/cm (in October 25th, 2019) at MD1A when the flow conditions changed from high to low and no rain events. Moreover, October 25th was the date with higher EC value with 1323 µS/cm at MD2A. A similar behavior was seen in MD2B from September 12th, 2019 to March 13th, 2020, where values changed from 319 µS/cm under high flow to 860 µS/cm under low flow. Also, there is a decrease in conductivity from March 13th to 16th, 2020, from 762 to 657 µS/cm in MD1B after some raining events happened in the area under a low flow. But EC appeared to increase a bit with some rain in April to 783 µS/cm. In May at this site during dry weather, EC was higher at 856 µS/cm. Finally, the conductivity values in MD2A* show the smaller amount (~168 µS/cm) measured in MD under low-flow wet conditions *(Table 5)*. The results showed that small rain events allow some dilution of the salts in MD. In addition, conductivity as well as nitrate tends to increase at the end of the irrigation season (e.g., October), when the flow is the lowest

and might allow some groundwater drainage. On the contrary, low salinity (EC value) is incorporated by surface water inflow to MD during the warmer months with high flow conditions, for example in September, when the irrigation season is still going.

Total Suspended Solids

Total suspended solids (TSS) are solids that do not settle out of slow-moving water and are above around 1 µm in size. Suspended solids can be harmful to a waterbody because they can block light from reaching submerged vegetation, which can cause less dissolved oxygen to be released into the water, potentially creating an anoxic environment. Suspended solids can also increase surface water temperature because of the property of absorption of heat from sunlight (*Kadlec and Wallace, 2009)*. Aesthetically, TSS can increase the turbidity and decrease the clarity of water, which makes waters undesirable in surface recreation, as well as wetlands that are also available to the public. Additionally, suspended solids are sometimes used as a proxy to determine the concentrations of pathogens, nutrients, pesticides, and metals in water since they tend to stick to sediment.

TSS measured in MD1A has a mean value of 87 mg/L, while MD2B has a mean value of 39.5 mg/L under the high-flow dry conditions. Station MD2A has the higher values of 218 mg/L during October 25th, 2019, and a decrement to 143 mg/L by April 2020, both under low-flow conditions but with some rain as a difference. This indicates a relatively high concentration of solids coming from the pump station into MD. Finally, MD1B during low-flow wet conditions (March to May 2020) showed the lowest values with a mean of 19 mg/L (*Table 6).* The average value of all the stations together is around 80 mg/L, slightly higher than the typical values for agricultural runoff of seen of around 55 mg/L (*Kadlec and Wallace, 2009) (Fig. 6)*. These TSS levels are not especially high and should not overwhelm or fill in a constructed treatment wetland, and flow through the wetland will likely remove some fraction of incoming TSS.

Pesticides

Pesticides are a necessary component of industrial agriculture and have been synthesized to have maximum effect on a narrow range of organisms. However, there are unintended human and ecological health consequences associated with even moderate amounts of pesticides in the water. We collected a single sample in MD and tested for pyrethroids, organophosphates, organochlorines and organonitrogen compounds. No pesticides were detected. The complete dataset is included in Appendix B and select data is summarized in *Table 6*.

PESTICIDES MILLER DITCH, NEWMAN CITY		
Type	**Amount [ug/L]**	**Repot limit [ug/L]**
CARFENTRZON	ND	2
CHLORPYRIFOS	ND	0.3
DIMETHOATE	ND	0.5
OXYFLUORFEN	ND	0.04
PENDIMETHALIN	ND	0.02
SIMAZINE	ND	0.5

Table 6. Select pesticides measured in Miller Ditch and used in region as reported by Westside San Joaquin River Watershed Coalition, 2014 Semi-Annual Monitoring Report

5. Comparison with Newman Wasteway data

To better understand the variability in water quality coming into any future wetland, a comparison between water quality in the Newman Wasteway (NWy) and MD is presented. MD is one of many irrigation ditches that discharge into the NWy, which ultimately discharges to the San Joaquin River (*Fig. 7).* The Westside San Joaquin River Watershed Coalition (WSJRWC) performs a wide range of water quality monitoring in the region for field parameters, nutrients, sediment, pathogens, and pesticides. The closest monitoring station to the MD is "Newman Wasteway near Hills Ferry Road." This station is roughly 1 km downstream of where MD discharges into NWy (*Fig. 7*). We corresponded with Orvil McKinnis of the WSJRWC who shared a water quality data set specifically for the Hills Ferry Road station. The data is from 2015 to 2019 and includes dissolved oxygen, flow, ammonia, nitrate, phosphate, total phosphorus, TSS, E. Coli, and metals, pathogens, and pesticides (*Appendix C*).

The general water chemistry of NWy indicates a range of dissolved oxygen (DO) between 1.4 to 8 mg/L with an average value of 4.8 mg/L, a flow of 6 m^3/s, and a pH of 7.43 *(Table 7*). In MD, the values are quite similar, except in the flow estimation, which is smaller, with of 0.1 m^3/s on average. DO measurements at both sites are below saturation, indicating oxygen consumption via respiration exceeds oxygen production via photosynthesis (*Table 7*).

Newman Wasteway at Hills Ferry Road	Miller Ditch
DO = 4.8 mg/L pH = 7.48 Flow = 6 m^3/s EC = 1172 µS/cm	DO = 5.4 mg/L pH = 7.29 Flow ~0.1 m^3/s EC = 1073 µS/cm

Table 7. Water quality field data comparison between Newman Wasteway sample site (fig. 7) and Miller Ditch in Newman City in May 2020. Information taken from WSJRWC, 2014

Regarding nutrients, ammonia concentration in NWy has an average of 0.34 mg-N/L with values ranging from 0 to 1.1 mg-N/L. MD concentration during high-flow dry conditions showed a concentration of 0 mg/L, but increased to 0.69 mg-N/L when the flow decreased and after some raining events were seen in the area, which is still consistent with the results presented for NWy. Likewise, nitrate concentration, in the multiple sites in MD are inside the range of NWy (0.2-3.2 mg-N/L), except for the sample taken in October 25th 2019 in which nitrate concentration is 8.35 mg-N/L at MD1A *(Table 5 and 7).* For phosphorus, NWy concentration was around 0.04 to 0.65 mg-P/L for TP and 0.05 to 0.40 mg-P/L for phosphate; values in MD follow the same ranges. TSS is slightly smaller in NWy, with a range of 6 to 140 mg/L, compared to MD concentration which varies from 13 to 218 mg/L. In summary, general water quality in MD and NWy are very similar, and this builds our confidence that we are adequately assessing water quality in MD with our limited sampling effort.

NEWMAN WASTEWAY NEAR HILLS FERRY ROAD		
Water Chemistry	**Measurement (average from 2016 to 2019)**	**Range**
Dissolved Oxygen (DO) [mg/L]	4.8	1.42 – 8
Flow [cfs]	210.52	0 – 356.4
Ammonia [mg/L]	0.34	0 – 1.1
Nitrate [mg/L]	1.02	0.2 – 3.2
Phosphate [mg/L]	0.13	0.05 – 0.48
Total Phosphorus [mg/L]	0.28	0.04 – 0.65
TSS [mg/L]	48	6 – 140
E.Coli [MPN/100ml]	621.55	4.7 – 2419

Table 8. NWNHFR average reported data from 2015 to 2019 (WSJRWC, 2014 report and WSJRWC data provided by Orvil McKinnis)

Pesticides were not a focus of this study or our ongoing monitoring at the site. But we did collect one sample in MD and no pesticides were detected. The WSJRWC samples for pesticides as part of their comprehensive monitoring effort in the region, but we did not ask them for this data, instead focusing on nutrients. While detailing the level of pesticides in MD is beyond the scope of this study, pesticides appear to be only occasionally detected in NWy. Based on data in the WSJRWC's Semi-Annual Monitoring Report 2013/2014 (see p. 111), which is available on-line, NWy had only 1 exceedances for DDE, diazinon and diuron and 2 exceedances for dimethoate from around 26 tests. Results suggest the frequency of pesticides coming into any future treatment wetland will be very low, and it is likely any trace levels of pesticides would be removed by the treatment wetland.

6. CONCLUSIONS

- Under high flow dry conditions, fairly-clean imported surface water is seen in MD with low concentration of ammonia and phosphorus. However, it seems to have groundwater infiltration at the beginning of the low flow dry conditions, after the active fertilization agronomic season (MD1A), which also has high nitrate and salinity values at the pump station coming into MD (MD2A). Finally, during low-flow wet conditions the water seems to have some dilution with raining water and urban runoff from the pump station, because all the concentrations went down except for ammonia, which is higher, showing some decay of organic matter in urban runoff. TSS appears higher in water coming from the pump station (MD2A) which presents higher amounts of sediment, but low salinity.
- Nitrates concentration in MD is generally low; however, for better removal, anaerobic conditions for denitrifying bacteria must be ensured, as well as high residence time, in the treatment wetland so microbial denitrification can remove the nutrient efficiently. Nitrate removal in the treatment wetland will be modeled in Memo 3.
- Ammonia was probably generated by decaying of organic matter from the urban runoff, which concentration is a relatively high compared to typical agricultural storm waters. Ammonia can be removed by nitrifying bacteria, which transforms ammonia into nitrate, and by plant uptake. With the low amounts of ammonia observed, the prospected wetland will be agronomic in nature, meaning plant uptake and burial will be the main removal mechanism.
- Phosphorus concentration presents typical values seen in agriculture waters. However, to have better removal, a large wetland is generally needed because removal is by plant uptake and burial, a seasonal process and long-term sink, which is not as fast and effective as microbial mediation of the nitrogen cycle. Phosphorus removal in the treatment wetland will be also modeled in Memo 3.
- TSS presented an increment in concentration when the conditions change from high- to low-flow near the pump station area. TSS can be reduced in treatment wetlands via sediments enhanced by low water velocity and physical filtering by plant stems in the wetland. Vegetation can also prevent some resuspension of the solids by decreasing wind mixing of water. The TSS levels are not especially high and suggest sediments will not fill in the wetland in the near term. TSS removal in the treatment wetland will be modeled in Memo 3.
- Medium-high salt concentration measured as conductivity was found through MD, as expected, due to principal activity of agriculture in the region. But summer irrigation flows in MD were generally low in salinity and could be harvested to dilute land application of treated wastewater in the region. Since water evaporates in treatment wetlands, salinity increases through treatment wetlands. Salinity increases in the treatment wetland will be modeled in Memo 3. Initial results indicate that

increases in salinity will be modest and will not impact the ability to reuse low-salinity MD water for land application and ground water recharge.

- Finally, the values compared between NWy and MD are highly similar showing the same agricultural origin of the water in both channels. This similarity indicates we are adequately assessing water quality in MD with our limited sampling effort.

7. REFERENCES

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8. FIGURES

Fig. 1. Modified image from Newman City report showing the four different projects planned for the area: NEWS in northwest corner; natural/restored wetland in middle-east; educational area in southeast corner; Miller Ditch treatment wetland in southeast corner – the focus of this study.

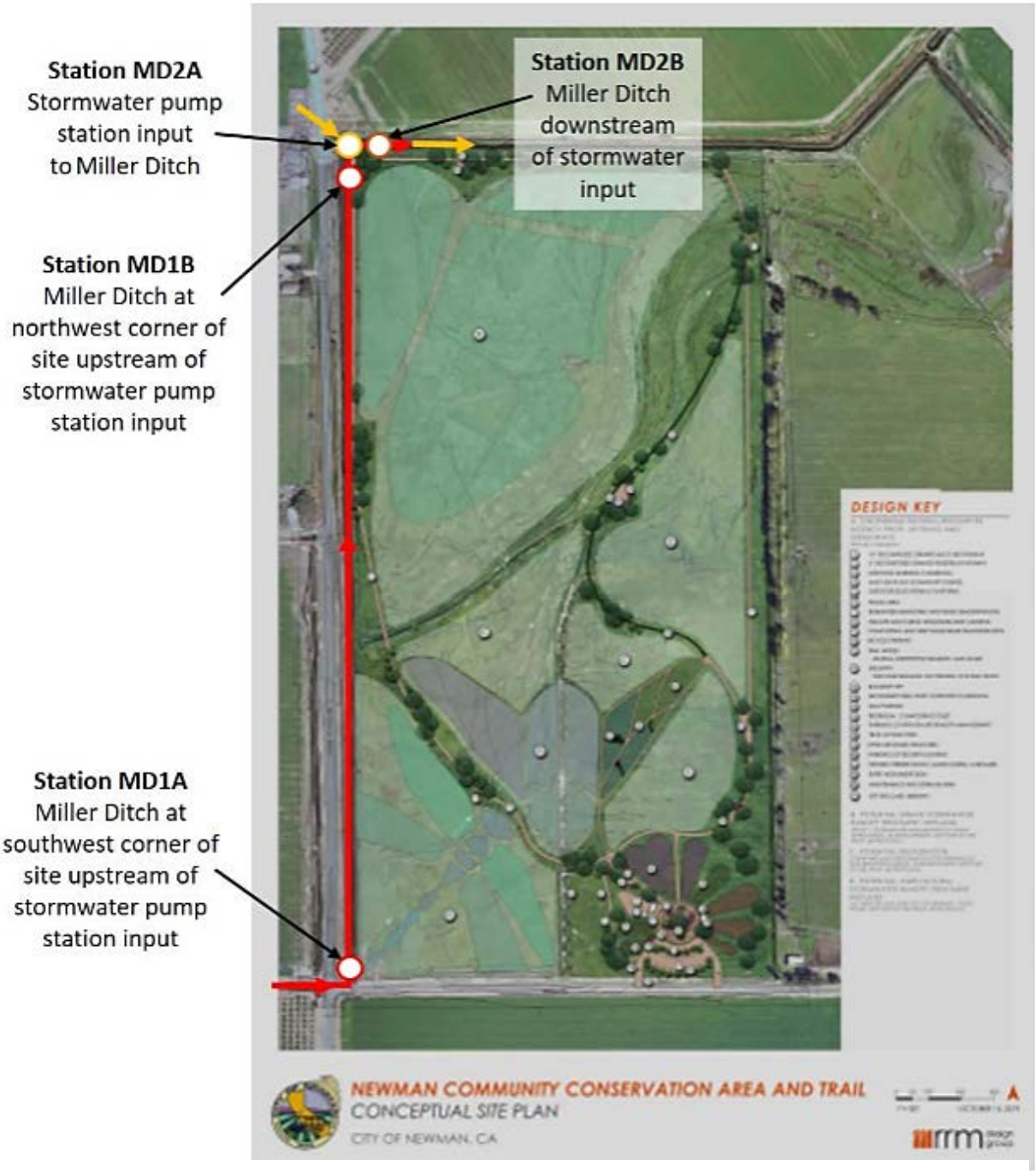

Fig. 2. Modified image from Newman City report where the four sampling locations are identified with a brief description of what the sampling location represents.

Fig. 3. Picture showing some methods used for the characterization of Miller Ditch water quality and flow. a) Filtering of the samples for the nutrient's analysis. b) Comparison of TSS between September 12th, 2019 and April 6th, 2020. c) Method used for the velocity estimation in Miller Ditch. d) Field data measured (DO, pH, T, and conductivity).

Fig. 4. Pictures from station MD2A at different sampling dates for flow coming into Miller Ditch. a) Picture taken September 12th, 2019 with no flow from the pump station and water gray in color. b) Picture taken on March 13th, 2020. The water presented a greenish color and no flow from pump station. c) Picture taken on March 16th in between the pump station discharge every 15 minutes. d) Picture taken on April 6th during the discharge from the pump station, water gray color.

Fig. 5. Flow comparison at Miller Ditch (MD) during the multiple sampling events. a) MD high flow during September 12th, 2019. b) Decreased flow during October 25th, 2019. c) Low-flow conditions during March 13th, 2020. d) Low-flow conditions at MD during April 6th, 2020.

TABLE 16.8
Composition and Mass Loading Rates for Stormwaters

	Urban		Industrial		Residential/Commercial		Agricultural	
Constituent	Concentration (mg/L)	Load (kg/ha·yr)	Concentration (mg/L)	Load (kg/ha·yr)	Concentration (mg/L)	Load (kg/ha·yr)	Concentration (mg/L)	Load (kg/ha·yr)
BOD_5	20 (7–56)	90	9.6	34–98	3.6–20	31.59–135.2	3.8	11.59
COD	75 (20–275)	—	—	—	—	—	—	—
TSS	150 (20–2890)	360	93.9	672–954.5	18–140	84.28–797	55.3	24.14
VSS	88 (53–122)	—	—	—	—	—	—	—
NH_3N	0.582	—	—	—	—	—	0.33–0.48	—
TKN	1.4 (0.57–4.2)	—	—	—	—	—	2.16–2.27	—
TN	2.0 (0.7–20)	11.2	1.79	7.8–18.06	1.1–2.8	9.144–32.18	2.32	10.61
Ortho-P	0.12	—	0.13	1.321	0.05–0.40	0.568–3.302	0.13–0.227	0.942
TP	0.36 (0.02–4.3)	3.4	0.31	2.2–3.151	0.14–0.51	1.412–4.85	0.344	1.362
Copper	0.05 (0.01–0.40)	0.049	—	0.077	—	0.045	—	—
Lead	0.18 (0.01–1.20)	0.174	0.202	0.269–2.053	0.065–0.214	0.157–2.431	—	—
Zinc	0.20 (0.01–2.9)	0.630	0.122	0.98–1.240	0.046–0.170	0.218–1.88	—	—
Chromium	—	0.28	—	0.044	—	0.026	—	—
Cadmium	0.0015	0.16	—	0.024	—	0.013	—	—
Iron	8.7	—	—	—	—	—	—	—
Mercury	0.00005	0.043	—	0.065	—	0.038	—	—
Nickel	0.022	0.032	—	0.030	—	0.029	—	—
Oil and Grease	2.6	—	—	—	—	—	—	—

Fig 6. Table taken from Kadlec and Wallace (2009) showing typical concentrations for storm water emphasizing agricultural composition.

Fig. 7. Satellite image showing study site (red box), Miller Ditch (red), Newman Wasteway (orange), and Newman Wasteway at Hills Ferry Road sampling station (orange square). Map provided by Drew Guintini of the Central California Irrigation District.

9. APPENDIX

- Appendix A – Caltest Water Analysis Report
- Appendix B – EMA Pesticide Report
- Appendix C – Water Quality Data from WSJRWC for Newman Wasteway at Hills Ferry Road

Caltest
ANALYTICAL LABORATORY
ENVIRONMENTAL ANALYSES

Tuesday, June 09, 2020

Marc Beutel
UC Merced, School of Engineering
5200 Lake Road
Merced, CA 95343

Re	Lab Order:	V050820	Collected By:	MARC BEUTEL
	Project ID:	Nutrients	PO/Contract #:	F100 N XA284 00

Dear Marc Beutel:

Enclosed are the analytical results for sample(s) received by the laboratory on Friday, May 22, 2020. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Enclosures

Project Manager: Melinda F. Kelley

1885 North Kelly Road • Napa, California 94558
(707) 258-4000 • Fax (707) 226-1001 • e-mail: info@caltestlabs.com

SAMPLE SUMMARY

Lab Order: V050820
Project ID: Nutrients

Lab ID	Sample ID	Matrix	Date Collected	Date Received
V050820001	**MD1B**	Water	03/13/2020 00:00	05/22/2020 09:32
V050820002	**MD2B**	Water	03/13/2020 00:00	05/22/2020 09:32
V050820003	**MD1B**	Water	03/16/2020 00:00	05/22/2020 09:32
V050820004	**MD2A***	Water	03/16/2020 00:00	05/22/2020 09:32
V050820005	**MD1B**	Water	04/06/2020 00:00	05/22/2020 09:32
V050820006	**MD2A**	Water	04/06/2020 00:00	05/22/2020 09:32
V050820007	**MD2A***	Water	04/06/2020 00:00	05/22/2020 09:32

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(707) 258-4000 • Fax (707) 226-1001 • e-mail: info@caltestlabs.com

NARRATIVE

Lab Order: V050820
Project ID: Nutrients

General Qualifiers and Notes

Caltest authorizes this report to be reproduced only in its entirety. Results are specific to the sample(s) as submitted and only to the parameter(s) reported.

Caltest certifies that all test results for wastewater and hazardous waste analyses meet all applicable NELAC requirements; all microbiology and drinking water testing meet applicable ELAP requirements, unless stated otherwise.

All analyses performed by EPA Methods or Standard Methods.

Dilution Factors (DF) reported greater than '1' have been used to adjust the result, Reporting Limit (RL), and Method Detection Limit (MDL).

All Solid, sludge, and/or biosolids data is reported in Wet Weight, unless otherwise specified.

Filtrations performed at Caltest for dissolved metals (excluding mercury) and/or pH analysis are not performed within the 15 minute holding time as specified by 40CFR 136.3 table II.

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

ND - indicates analytical result has not been detected at or above the Reporting Limit (RL), or at above the Method Detection Limit (MDL) when it is included on the report and is not otherwise noted.

RL - Reporting Limit is the quantitation limit at which the laboratory is able to detect an analyte. An analyte not detected at or above the RL is reported as ND unless otherwise noted or qualified. For analyses pertaining to the State Implementation Plan of the California Toxics Rule, the Caltest Reporting Limit (RL) is equivalent to the Minimum Level (ML). A standard is always run at or below the ML. Where Reporting Limits are elevated due to dilution, the ML calibration criteria has been met.

MDL - The Method Detection Limit is defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from method blank results.

J - reflects estimated analytical result value detected below the Reporting Limit (RL) and above the Method Detection Limit (MDL). The 'J' flag is equivalent to the DNQ Estimated Concentration flag.

B - indicates the analyte has been detected in the blank associated with the sample.

SS - compound is a Surrogate Spike used per laboratory quality assurance manual.

NOTE: This document represents a complete Analytical Report for the samples referenced herein and should be retained as a permanent record thereof.

Qualifiers and Compound Notes

1	Sample received and analyzed past the regulatory holding time.

1885 North Kelly Road • Napa, California 94558
(707) 258-4000 • Fax (707) 226-1001 • e-mail: info@caltestlabs.com

ANALYTICAL RESULTS

Lab Order: V050820
Project ID: Nutrients

Lab ID **V050820001** Date Collected 3/13/2020 00:00 Matrix Water
Sample ID **MD1B** Date Received 5/22/2020 09:32

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Nitrogen, Ammonia (as N),Low Level,DISS		**Analytical Method:**	SM 4500-NH3 G-11 (LL)					**Analyzed by:**	JDC	
Ammonia (as N)	0.038	mg/L	0.02	0.015	1			06/02/20 17:28	WAT 5341	
OrthoPhosphate Analysis,Diss,Low Level		**Analytical Method:**	SM 4500-P E-99/-11 (LL, Filt)					**Analyzed by:**	DR	
Dissolved Ortho Phosphate as P	0.019	mg/L	0.01	0.0060	1			05/22/20 13:05	WCO 15658	1
Phosphorus Analysis, Low Level		**Analytical Method:**	SM 4500-P B/F-11 (LL)					**Analyzed by:**	DR	
Total Phosphorus as P	0.065	mg/L	0.01	0.0070	1			05/26/20 18:02	WCO 15660	1
Anions by Ion Chromatography		**Analytical Method:**	EPA 300.0					**Analyzed by:**	MYS	
Nitrogen, Nitrate (as N)	1.7	mg/L	0.1	0.040	2			05/23/20 05:12	WIC 7076	1

Lab ID **V050820002** Date Collected 3/13/2020 00:00 Matrix Water
Sample ID **MD2B** Date Received 5/22/2020 09:32

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Nitrogen, Ammonia (as N),Low Level,DISS		**Analytical Method:**	SM 4500-NH3 G-11 (LL)					**Analyzed by:**	JDC	
Ammonia (as N)	0.22	mg/L	0.02	0.015	1			06/02/20 17:30	WAT 5341	
OrthoPhosphate Analysis,Diss,Low Level		**Analytical Method:**	SM 4500-P E-99/-11 (LL, Filt)					**Analyzed by:**	DR	
Dissolved Ortho Phosphate as P	0.053	mg/L	0.01	0.0060	1			05/22/20 13:05	WCO 15658	1
Phosphorus Analysis, Low Level		**Analytical Method:**	SM 4500-P B/F-11 (LL)					**Analyzed by:**	DR	
Total Phosphorus as P	0.11	mg/L	0.01	0.0070	1			05/26/20 18:03	WCO 15660	1
Anions by Ion Chromatography		**Analytical Method:**	EPA 300.0					**Analyzed by:**	MYS	
Nitrogen, Nitrate (as N)	2.5	mg/L	0.1	0.040	2			05/23/20 05:29	WIC 7076	1

Lab ID **V050820003** Date Collected 3/16/2020 00:00 Matrix Water
Sample ID **MD1B** Date Received 5/22/2020 09:32

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Nitrogen, Ammonia (as N),Low Level,DISS		**Analytical Method:**	SM 4500-NH3 G-11 (LL)					**Analyzed by:**	JDC	
Ammonia (as N)	0.027	mg/L	0.02	0.015	1			06/02/20 17:33	WAT 5341	
OrthoPhosphate Analysis,Diss,Low Level		**Analytical Method:**	SM 4500-P E-99/-11 (LL, Filt)					**Analyzed by:**	DR	
Dissolved Ortho Phosphate as P	0.025	mg/L	0.01	0.0060	1			05/22/20 13:05	WCO 15658	1
Phosphorus Analysis, Low Level		**Analytical Method:**	SM 4500-P B/F-11 (LL)					**Analyzed by:**	DR	

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ANALYTICAL RESULTS

Lab Order: V050820
Project ID: Nutrients

Lab ID **V050820003** Date Collected 3/16/2020 00:00 Matrix Water
Sample ID **MD1B** Date Received 5/22/2020 09:32

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Total Phosphorus as P	0.10	mg/L	0.01	0.0070	1			05/26/20 18:08	WCO 15660	1
Anions by Ion Chromatography		**Analytical Method:**	EPA 300.0					**Analyzed by:**	MYS	
Nitrogen, Nitrate (as N)	0.28	mg/L	0.1	0.040	2			05/23/20 05:46	WIC 7076	1

Lab ID **V050820004** Date Collected 3/16/2020 00:00 Matrix Water
Sample ID **MD2A*** Date Received 5/22/2020 09:32

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Nitrogen, Ammonia (as N),Low Level,DISS		**Analytical Method:**	SM 4500-NH3 G-11 (LL)					**Analyzed by:**	JDC	
Ammonia (as N)	0.43	mg/L	0.02	0.015	1			06/02/20 17:36	WAT 5341	
OrthoPhosphate Analysis,Diss,Low Level		**Analytical Method:**	SM 4500-P E-99/-11 (LL, Filt)					**Analyzed by:**	DR	
Dissolved Ortho Phosphate as P	0.17	mg/L	0.01	0.0060	1			05/22/20 13:05	WCO 15658	1
Phosphorus Analysis, Low Level		**Analytical Method:**	SM 4500-P B/F-11 (LL)					**Analyzed by:**	DR	
Total Phosphorus as P	0.27	mg/L	0.01	0.0070	1			05/26/20 18:09	WCO 15660	1
Anions by Ion Chromatography		**Analytical Method:**	EPA 300.0					**Analyzed by:**	MYS	
Nitrogen, Nitrate (as N)	1.0	mg/L	0.1	0.040	2			05/23/20 06:04	WIC 7076	1

Lab ID **V050820005** Date Collected 4/6/2020 00:00 Matrix Water
Sample ID **MD1B** Date Received 5/22/2020 09:32

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Nitrogen, Ammonia (as N),Low Level,DISS		**Analytical Method:**	SM 4500-NH3 G-11 (LL)					**Analyzed by:**	JDC	
Ammonia (as N)	0.19	mg/L	0.02	0.015	1			06/02/20 17:38	WAT 5341	
OrthoPhosphate Analysis,Diss,Low Level		**Analytical Method:**	SM 4500-P E-99/-11 (LL, Filt)					**Analyzed by:**	DR	
Dissolved Ortho Phosphate as P	0.28	mg/L	0.01	0.0060	1			05/22/20 13:05	WCO 15658	1
Phosphorus Analysis, Low Level		**Analytical Method:**	SM 4500-P B/F-11 (LL)					**Analyzed by:**	DR	
Total Phosphorus as P	0.41	mg/L	0.01	0.0070	1			05/26/20 18:11	WCO 15660	1
Anions by Ion Chromatography		**Analytical Method:**	EPA 300.0					**Analyzed by:**	MYS	
Nitrogen, Nitrate (as N)	0.57	mg/L	0.1	0.040	2			05/23/20 06:21	WIC 7076	1

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ANALYTICAL RESULTS

Lab Order: V050820
Project ID: Nutrients

Lab ID **V050820006** Date Collected 4/6/2020 00:00 Matrix Water
Sample ID **MD2A** Date Received 5/22/2020 09:32

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Nitrogen, Ammonia (as N),Low Level,DISS		**Analytical Method:**	SM 4500-NH3 G-11 (LL)					**Analyzed by:**	JDC	
Ammonia (as N)	0.69	mg/L	0.02	0.015	1			06/02/20 17:52	WAT 5341	
OrthoPhosphate Analysis,Diss,Low Level		**Analytical Method:**	SM 4500-P E-99/-11 (LL, Filt)					**Analyzed by:**	DR	
Dissolved Ortho Phosphate as P	0.15	mg/L	0.01	0.0060	1			05/22/20 13:05	WCO 15658	1
Phosphorus Analysis, Low Level		**Analytical Method:**	SM 4500-P B/F-11 (LL)					**Analyzed by:**	DR	
Total Phosphorus as P	0.41	mg/L	0.01	0.0070	1			05/26/20 18:12	WCO 15660	1
Anions by Ion Chromatography		**Analytical Method:**	EPA 300.0					**Analyzed by:**	MYS	
Nitrogen, Nitrate (as N)	0.56	mg/L	0.1	0.040	2			05/23/20 06:38	WIC 7076	1

Lab ID **V050820007** Date Collected 4/6/2020 00:00 Matrix Water
Sample ID **MD2A*** Date Received 5/22/2020 09:32

Parameters	Result	Units	R. L.	MDL	DF	Prepared	Batch	Analyzed	Batch	Qual
Nitrogen, Ammonia (as N),Low Level,DISS		**Analytical Method:**	SM 4500-NH3 G-11 (LL)					**Analyzed by:**	JDC	
Ammonia (as N)	0.62	mg/L	0.02	0.015	1			06/02/20 17:54	WAT 5341	
OrthoPhosphate Analysis,Diss,Low Level		**Analytical Method:**	SM 4500-P E-99/-11 (LL, Filt)					**Analyzed by:**	DR	
Dissolved Ortho Phosphate as P	0.13	mg/L	0.01	0.0060	1			05/22/20 13:05	WCO 15658	1
Phosphorus Analysis, Low Level		**Analytical Method:**	SM 4500-P B/F-11 (LL)					**Analyzed by:**	DR	
Total Phosphorus as P	0.54	mg/L	0.01	0.0070	1			05/26/20 18:14	WCO 15660	1
Anions by Ion Chromatography		**Analytical Method:**	EPA 300.0					**Analyzed by:**	MYS	
Nitrogen, Nitrate (as N)	1.6	mg/L	0.1	0.040	2			05/23/20 06:55	WIC 7076	1

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QUALITY CONTROL DATA

Lab Order: V050820
Project ID: Nutrients

Analysis Description:	Nitrogen, Ammonia (as N),Low Level,DISS	**QC Batch:**	WAT/5341
Analysis Method:	SM 4500-NH3 G-11 (LL)	**QC Batch Method:**	SM 4500-NH3 G-11 (LL)

METHOD BLANK: 949718

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Ammonia (as N)	ND	0.02	0.015	mg/L	

LABORATORY CONTROL SAMPLE & LCSD: 949719 949720

Parameter	Units	Spike Conc.	LCS Result	LCSD Result	LCS % Rec	LCSD % Rec	% REC Limits	RPD	Max RPD	Qualifier
Ammonia (as N)	mg/L	0.5	0.512	0.511	102	102	80-120	0.2	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 949723 949724

Parameter	Units	V050040082 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Ammonia (as N)	mg/L	0.51	0.5	1.04	1.04	106	106	80-120	0	20	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 949726 949727

Parameter	Units	V050037019 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Ammonia (as N)	mg/L	0.37	0.5	0.942	0.94	114	114	80-120	0.2	20	

Analysis Description:	OrthoPhosphate Analysis,Diss,Low Level	**QC Batch:**	WCO/15658
Analysis Method:	SM 4500-P E-99/-11 (LL, Filt)	**QC Batch Method:**	SM 4500-P E-99/-11 (LL, Filt)

FILTER BLANK: 948542

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Ortho Phosphate as P	ND	0.01	0.006	mg/L	

METHOD BLANK: 948538

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Ortho Phosphate as P	ND	0.01	0.006	mg/L	

LABORATORY CONTROL SAMPLE: 948539

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% REC Limits	Qualifier
Ortho Phosphate as P	mg/L	0.2	0.197	99	90-110	

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QUALITY CONTROL DATA

Lab Order: V050820
Project ID: Nutrients

Analysis Description:	OrthoPhosphate Analysis,Diss,Low Level	**QC Batch:**	WCO/15658
Analysis Method:	SM 4500-P E-99/-11 (LL, Filt)	**QC Batch Method:**	SM 4500-P E-99/-11 (LL, Filt)

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 948540 948541

Parameter	Units	V050816001 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Ortho Phosphate as P	mg/L	0.061	0.2	0.26	0.262	100	101	90-110	0.8	20	

Analysis Description:	Phosphorus Analysis, Low Level	**QC Batch:**	WCO/15660
Analysis Method:	SM 4500-P B/F-11 (LL)	**QC Batch Method:**	SM 4500-P B/F-11 (LL)

METHOD BLANK: 948660

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Total Phosphorus as P	ND	0.01	0.007	mg/L	

LABORATORY CONTROL SAMPLE: 948661

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% REC Limits	Qualifier
Total Phosphorus as P	mg/L	1	0.969	97	90-110	

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 948662 948663

Parameter	Units	V050040001 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Total Phosphorus as P	mg/L	0.02	1	1.01	1	99	98	90-110	1	20	

Analysis Description:	Anions by Ion Chromatography	**QC Batch:**	WIC/7076
Analysis Method:	EPA 300.0	**QC Batch Method:**	EPA 300.0

METHOD BLANK: 948957

Parameter	Blank Result	Reporting Limit	MDL	Units	Qualifiers
Nitrogen, Nitrate (as N)	ND	0.1	0.02	mg/L	

LABORATORY CONTROL SAMPLE: 948958

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	% REC Limits	Qualifier
Nitrogen, Nitrate (as N)	mg/L	2.5	2.53	101	90-110	

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QUALITY CONTROL DATA

Lab Order: V050820
Project ID: Nutrients

Analysis Description:	Anions by Ion Chromatography	**QC Batch:**	WIC/7076
Analysis Method:	EPA 300.0	**QC Batch Method:**	EPA 300.0

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 948959 948960

Parameter	Units	V050821001 Result	Spike Conc.	MS Result	MSD Result	MS % Rec	MSD % Rec	% Rec Limit	RPD	Max RPD	Qualifiers
Nitrogen, Nitrate (as N)	mg/L	0.5	4	4.61	4.62	103	103	80-120	0.2	20	

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ENVIRONMENTAL ANALYSES

QUALITY CONTROL DATA QUALIFIERS

Lab Order: V050820
Project ID: Nutrients

QUALITY CONTROL PARAMETER QUALIFIERS

Results Qualifiers: Report fields may contain codes and non-numeric data correlating to one or more of the following definitions:

NS - means not spiked and will not have recoveries reported for Analyte Spike Amounts

QC Codes Keys: These descriptors are used to help identify the specific QC samples and clarify the report.

MB - Method Blank

Method Blanks are reported to the same Method Detection Limits (MDLs) or Reporting Limits (RLs) as the analytical samples in the corresponding QC batch.

LCS/LCSD - Laboratory Control Spike / Laboratory Control Spike Duplicate

DUP - Duplicate of Original Sample Matrix

MS/MSD - Matrix Spike / Matrix Spike Duplicate

RPD - Relative Percent Difference

%Recovery - Spike Recovery stated as a percentage

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Lab Order: V050820
Project ID: Nutrients

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
V050820001	**MD1B**	SM 4500-NH3 G-11 (LL)	WAT/5341		
V050820002	**MD2B**	SM 4500-NH3 G-11 (LL)	WAT/5341		
V050820003	**MD1B**	SM 4500-NH3 G-11 (LL)	WAT/5341		
V050820004	**MD2A***	SM 4500-NH3 G-11 (LL)	WAT/5341		
V050820005	**MD1B**	SM 4500-NH3 G-11 (LL)	WAT/5341		
V050820006	**MD2A**	SM 4500-NH3 G-11 (LL)	WAT/5341		
V050820007	**MD2A***	SM 4500-NH3 G-11 (LL)	WAT/5341		
V050820001	**MD1B**	SM 4500-P E-99/-11 (LL,	WCO/15658		
V050820002	**MD2B**	SM 4500-P E-99/-11 (LL,	WCO/15658		
V050820003	**MD1B**	SM 4500-P E-99/-11 (LL,	WCO/15658		
V050820004	**MD2A***	SM 4500-P E-99/-11 (LL,	WCO/15658		
V050820005	**MD1B**	SM 4500-P E-99/-11 (LL,	WCO/15658		
V050820006	**MD2A**	SM 4500-P E-99/-11 (LL,	WCO/15658		
V050820007	**MD2A***	SM 4500-P E-99/-11 (LL,	WCO/15658		
V050820001	**MD1B**	SM 4500-P B/F-11 (LL)	WCO/15660		
V050820002	**MD2B**	SM 4500-P B/F-11 (LL)	WCO/15660		
V050820003	**MD1B**	SM 4500-P B/F-11 (LL)	WCO/15660		
V050820004	**MD2A***	SM 4500-P B/F-11 (LL)	WCO/15660		
V050820005	**MD1B**	SM 4500-P B/F-11 (LL)	WCO/15660		
V050820006	**MD2A**	SM 4500-P B/F-11 (LL)	WCO/15660		
V050820007	**MD2A***	SM 4500-P B/F-11 (LL)	WCO/15660		
V050820001	**MD1B**	EPA 300.0	WIC/7076		
V050820002	**MD2B**	EPA 300.0	WIC/7076		
V050820003	**MD1B**	EPA 300.0	WIC/7076		
V050820004	**MD2A***	EPA 300.0	WIC/7076		
V050820005	**MD1B**	EPA 300.0	WIC/7076		
V050820006	**MD2A**	EPA 300.0	WIC/7076		
V050820007	**MD2A***	EPA 300.0	WIC/7076		

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PAGE _____ OF _____

SAMPLE CHAIN OF CUSTODY

PROJECT NAME / PROJECT NUMBER:

P.O. NUMBER: F100NXA28400

LAB ORDER # V050820

CLIENT: UC Merced, School of Engineering

REPORT ATTN: Marc Beutel

MAILING ADDRESS: 5200 Lake Road | CITY: Merced | STATE: CA | ZIP: 95343

BILLING ADDRESS: | ATTN:

PHONE NUMBER: (209) 228-2229 | EMAIL ADDRESS: mbeutel@ucmerced.edu | SAMPLER (PRINT & SIGN NAME): Marc Beutel

TURN-AROUND TIME: [X] STANDARD [ ] RUSH

DUE DATE:

ANALYSES REQUESTED

CALTEST SAMPLE #	DATE SAMPLED	TIME SAMPLED	SAMPLE MATRIX*	CONTAINER TYPE/ AMOUNT**	PRESERVATIVE	SAMPLE IDENTIFICATION / SITE	CLIENT LAB #	COMP. or GRAB	NH3.L.L.F	NO3N.W	PHOS.O.F.L.L	PHOS.T.L.L	Caltest- Use Profile 313829
1	3/13/2020		W	Falcon Tube	frozen	MD1B						x	Low Volume
2	3/13/2020		W	Falcon Tube	0.45 um filtered, frozen	MD1B			x	x	x		Low Volume
3	3/13/2020		W	Falcon Tube	frozen	MD2B						x	Low Volume
4	3/13/2020		W	Falcon Tube	0.45 um filtered, frozen	MD2B			x	x	x		Low Volume
5	3/16/2020		W	Falcon Tube	frozen	MD1B						x	Low Volume
6	3/16/2020		W	Falcon Tube	0.45 um filtered, frozen	MD1B			x	x	x		Low Volume
7	3/16/2020		W	Falcon Tube	frozen	MD2A*						x	Low Volume
8	3/16/2020		W	Falcon Tube	0.45 um filtered, frozen	MD2A*			x	x	x		Low Volume
9	4/6/2020		W	Falcon Tube	frozen	MD1B						x	Low Volume
10	4/6/2020		W	Falcon Tube	0.45 um filtered, frozen	MD1B			x	x	x		Low Volume
11	4/6/2020		W	Falcon Tube	frozen	MD2A						x	Low Volume
12	4/6/2020		W	Falcon Tube	0.45 um filtered, frozen	MD2A			x	x	x		Low Volume
13	4/6/2020		W	Falcon Tube	frozen	MD2A*						x	Low Volume
14	4/6/2020		W	Falcon Tube	0.45 um filtered, frozen	MD2A*			x	x	x		Low Volume
													Low Volume

RELINQUISHED BY	DATE/TIME	RECEIVED BY	RELINQUISHED BY	DATE/TIME	RECEIVED BY
Marc Beutel	5/21/20 12pm	Fed Ex	Fed Ex	5/22/20 0932	[illegible]

FOR LAB USE ONLY

TEMP: °C / °C | SEALED: Y / N | INTACT: Y / N | ON ICE: Y / N

Samples: WC ___ MICRO ___ BIO ___ MET ___ SV ___ VOA ___

BD: BIO ___ WC ___ MET ___

SIL: HP ___ PT ___ QT ___ VOA ___

W/HNO_3 ___ H_2SO_4 ___ NaOH ___

PIL: HNO_3 ___ H_2SO_4 ___ NaOH ___ HCl ___

REPORTING OPTIONS (Choose One): X EMAIL ___ MAIL ___ BOTH

COMMENTS: PLEASE RETURN COOLER TO THE ADDRESS BELOW FOR $25 FEE.

Marc Beutel, 4929 Schoolhouse Rd, Catheys Valley, CA 95306

TEMP 3.4 / 3.1 C

SEALED: (Y) / N INTACT: (Y) / N

ON ICE: (Y) / N

*MATRIX: W = Aqueous Nondrinking Water, Digested Metals; ML = Final Effluent, Minimum-Level/Low-Level R.L.; DW = Drinking Water; SL = Soil, Sludge, Solid ; FP = Free Product

**CONTAINER TYPES: AL = Amber Liter; AHL = 500 mL Amber; PT = Pint (Plastic); QT = Quart (Plastic); HG = Half Gallon (Plastic); SJ = Soil Jar; B4 = 4oz. BACT; BT = Brass Tube; VOA = 40mL VOA; OTC = Other Type Container

05/20/20

WHITE - LABORATORY YELLOW - CLIENT COPY TO ACCOMPANY FINAL REPORT PINK - CLIENT COPY AS RECEIPT

Environmental Micro Analysis, Inc.
460 N East Street
Woodland, CA 95776

ISO 17025 accreditation
ELAP Certificate #2819

Phone: (530) 666-6890 Fax: (530) 666-2987
e-mail: emalab@emalab.com website: www.emalab.com

Analytical Report

October 11, 2019

Client: Marc Beutel
UC Merced
5200 N. Lake Rd.
Merced , CA 95343
Phone: (209) 228-2229
Fax:
Email: mbeutel@ucmerced.edu

Project No: Newman Treatment Wetland

PO No:

Client Sample ID: Clear Ditch

Sample Date: 9/27/2019
EMA Sample No: 19100117-01
Date Received: 10/1/2019
Sample Matrix: Water

Analytical Method: EPA 8081B (w)(OC's)
Extraction Method: EPA 3510
Date Extracted: 10/4/2019
Date Completed: 10/9/2019

Surrogate: Dibutylchlordenate
Surrogate Level: 0.4
% Recovery: 74.0

Comments:

Analyte	Amount µg/L	RL µg/L
a, b, d-BHC	ND	0.05
Alachlor	ND	0.5
Alert	ND	0.05
Aldrin	ND	0.04
Benfluralin	ND	0.1
Bifenox	ND	0.1
Boscalid	ND	0.1
Bromacil	ND	0.05
Captafol	ND	0.04
Captan	ND	0.02
Chlordane (alpha+gamma)	ND	0.05
Chlorobenzilate	ND	0.1
Chlorothalonil	ND	0.04
Cyanazine	ND	0.1
Dacthal	ND	0.04
p,p'-DDD	ND	0.1
o,p'-DDE	ND	0.04
p,p'-DDE	ND	0.04
o,p'-DDT	ND	0.1
p,p'-DDT	ND	0.1
Dichlobenil	ND	0.3
Dichlone	ND	0.1
Dicloran	ND	0.1
Dicofol	ND	0.1
Dieldrin	ND	0.02
Dyrene	ND	1
Endosulfan alpha	ND	0.04
Endosulfan beta	ND	0.04
Endosulfan sulfate	ND	0.04
Endrin	ND	0.04
Ethafluralin	ND	0.1
Folpet	ND	0.1
Heptachlor	ND	0.03
Heptachlor epoxide	ND	0.05
Indoxacarb	ND	0.1
Iprodione	ND	0.1
Lindane (gamma-BHC)	ND	0.04
Linuron	ND	1
Methoxychlor	ND	1.7
Metribuzin	ND	0.05
Mirex	ND	0.05
Myclobutanil	ND	0.5
Oxadiazon	ND	0.1
Oxyfluorfen	ND	0.04
Pendimethalin	ND	0.02
Pentachloronitrobenzene (PCNB)	ND	0.04
Perthane	ND	0.1
Polychlorinated Biphenyls	ND	1.25
Profluralin	ND	0.1
Procymidone	ND	0.1
Pronamide	ND	0.2
Propiconazole	ND	1
Pyrethrins (Total)	ND	0.25
Tetradifon	ND	0.1
Toxaphene	ND	2.5
Triadimephon	ND	0.1
Triflumizole	ND	0.5
Trifloxystrobin	ND	0.1
Trifluralin	ND	0.1
Vegadex (Diethyldithiocarbamic Acid)	ND	0.1
Vinclozolin	ND	0.1

R = Reported on another Screen
ND = None Detected at the Reporting Limit (RL)
Tolerance data taken from 40 CFR § 180. Environmental Micro Analysis, Inc. makes no claims as to the accuracy of tolerance numbers.
Excess sample and extracts are stored for a minimum of 30 days from the date of analytical report. Special storage arrangements possible.
Results relate only to items tested.
Samples are analyzed as received.

To see the scope of our ISO 17025 accreditation go to http://emalab.com/ISO17025.pdf

Date: 10/11/19 Reviewed by: for Don Peterson Don Peterson, Laboratory Director

Environmental Micro Analysis, Inc.
460 N East Street
Woodland, CA 95776

ISO 17025 accreditation
ELAP Certificate #2819

Phone: (530) 666-6890 Fax: (530) 666-2987
e-mail: emalab@emalab.com website: www.emalab.com

Analytical Report

October 11, 2019

Analyte	Amount µg/L	RL µg/L
Bifenthrin	ND	0.1
Cyfluthrin	ND	0.25
Cypermethrin	ND	0.25
Deltamethrin	ND	0.25
Esfenvalerate	ND	0.1
Fenpropathrin	ND	0.05
Fenvalerate	ND	0.2
Fluvalinate	ND	0.25
lambda Cyhalothrin	ND	0.05
Permethrin	ND	0.25

Client: Marc Beutel
UC Merced
5200 N. Lake Rd.
Merced , CA 95343
Phone: (209) 228-2229
Fax:
Email: mbeutel@ucmerced.edu

Project No: Newman Treatment Wetland

PO No:

Client Sample ID: Clear Ditch

Sample Date: 9/27/2019
EMA Sample No: 19100117-01
Date Received: 10/1/2019
Sample Matrix: Water

Analytical Method: EPA 8081B (w) (Pyrethroids)
Extraction Method: EPA 3510
Date Extracted: 10/4/2019
Date Completed: 10/9/2019
Surrogate: Dibutylchlordenate
Surrogate Level: 0.4
% Recovery: 74.0

Comments:

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Date: 10/11/19 Reviewed by: for Don Peterson Don Peterson, Laboratory Director

Environmental Micro Analysis, Inc.
460 N East Street
Woodland, CA 95776

ISO 17025 accreditation
ELAP Certificate #2819

Phone: (530) 666-6890 Fax: (530) 666-2987
e-mail: emalab@emalab.com website: www.emalab.com

Analytical Report

October 11, 2019

Client: Marc Beutel
UC Merced
5200 N. Lake Rd.
Merced , CA 95343
Phone: (209) 228-2229
Fax:
Email: mbeutel@ucmerced.edu

Project No: Newman Treatment Wetland

PO No:

Client Sample ID: Clear Ditch

Sample Date: 9/27/2019
EMA Sample No: 19100117-01
Date Received: 10/1/2019
Sample Matrix: Water

Analytical Method: EPA 8141B (w) (OP's)
Extraction Method: EPA 3510
Date Extracted: 10/4/2019
Date Completed: 10/10/2019

Surrogate: Triphenylphosphate
Surrogate Level: 2.0
% Recovery: 106

Comments:

Analyte	Amount µg/L	RL µg/L
Azinphos-methyl	ND	0.5
Bolstar	ND	0.5
Bensulide	ND	0.5
Carbofenothion	ND	2
Chlorfenvinphos	ND	0.5
Chlorpyrifos	ND	0.3
Chlorpyrifos-methyl	ND	0.3
Ciodrin	ND	0.5
Coumaphos	ND	1.5
DEF	ND	0.5
Demeton (Systox) O/S Analogues	ND	0.5
Diazinon	ND	0.5
Dibrom	ND	0.5
Dicrotophos	ND	0.5
Dimethoate	ND	0.5
Disulfoton	ND	0.3
EPN	ND	1
Ethion	ND	0.5
Ethoprop	ND	0.5
Fenamiphos	ND	0.5
Fenitrothion	ND	0.5
Fenthion	ND	0.5
Fonofos	ND	0.5
Imidan	ND	0.5
Isofenphos	ND	0.5
Malathion	ND	0.5
Methidathion	ND	0.5
Methyl Parathion	ND	0.5
Mevinphos	ND	0.5
Parathion	ND	0.5
Phorate	ND	0.5
Phosalone	ND	1.5
Phosphamidon	ND	1
Pyrimiphos-methyl	ND	0.5
Profenofos	ND	1
Propetamphos	ND	0.5
Ronnel	ND	0.5
Tetrachlorvinphos	ND	0.5
Thionazin	ND	0.5

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e-mail: emalab@emalab.com website: www.emalab.com

Analytical Report

October 11, 2019

Client: Marc Beutel
UC Merced
5200 N. Lake Rd.
Merced , CA 95343
Phone: (209) 228-2229
Fax:
Email: mbeutel@ucmerced.edu

Project No: Newman Treatment Wetland

PO No:

Client Sample ID: Clear Ditch

Sample Date: 9/27/2019
EMA Sample No: 19100117-01
Date Received: 10/1/2019
Sample Matrix: Water

Analytical Method: EPA 8141B (w) (ON's)
Extraction Method: EPA 3510
Date Extracted: 10/4/2019
Date Completed: 10/10/2019
Surrogate: Triphenylphosphate
Surrogate Level: 2.0
% Recovery: 106

Comments:

Analyte	Amount µg/L	RL µg/L
Acetamiprid	ND	2
Ametryn	ND	0.5
Atrazine	ND	0.5
Azoxystrobin	ND	0.5
Benthiocarb	ND	2
Cyanazine	ND	0.5
Cyprodinil	ND	0.5
Diphenyl Amine	ND	2
Hexazinone	ND	1
Imazalil	ND	2
Metalaxyl	ND	2
Metolachlor	ND	1
Metribuzin	ND	1
Molinate	ND	1
Myclobutanil	ND	0.5
Prometon	ND	0.5
Prometryne	ND	0.5
Pyraclostrobin	ND	0.5
Pymetrozine	ND	0.5
Simazine	ND	0.5
Tebuconazole	ND	0.5
Terbacil	ND	5
Thiabendazole	ND	1

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Analyte	Amount µg/L	RL µg/L

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UC Merced
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Merced , CA 95343
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Fax:
Email: mbeutel@ucmerced.edu

Project No: Newman Treatment Wetland

PO No:

Client Sample ID: Clear Ditch

Sample Date: 9/27/2019
EMA Sample No: 19100117-01
Date Received: 10/1/2019
Sample Matrix: Water

Analytical Method: EPA 8318
Extraction Method: EPA 3510
Date Extracted: 10/4/2019
Date Completed: 10/10/2019

Surrogate:

Surrogate Level:

% Recovery:

Comments:

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October 11, 2019

Client: Marc Beutel
UC Merced
5200 N. Lake Rd.
Merced , CA 95343
Phone: (209) 228-2229
Fax:
Email: mbeutel@ucmerced.edu

Project No: Newman Treatment Wetland

PO No:

Client Sample ID: Blank

Sample Date:
EMA Sample No: 19100117-00
Date Received: 10/1/2019
Sample Matrix: Water

Analytical Method: EPA 8081B (w)(OC's)
Extraction Method: EPA 3510
Date Extracted: 10/4/2019
Date Completed: 10/9/2019

Surrogate: Dibutylchlordenate
Surrogate Level: 0.4
% Recovery: 65.6

Comments:

Analyte	Amount µg/L	RL µg/L
a, b, d-BHC	ND	0.05
Alachlor	ND	0.5
Alert	ND	0.05
Aldrin	ND	0.04
Benfluralin	ND	0.1
Bifenox	ND	0.1
Boscalid	ND	0.1
Bromacil	ND	0.05
Captafol	ND	0.04
Captan	ND	0.02
Chlordane (alpha+gamma)	ND	0.05
Chlorobenzilate	ND	0.1
Chlorothalonil	ND	0.04
Cyanazine	ND	0.1
Dacthal	ND	0.04
p,p'-DDD	ND	0.1
o,p'-DDE	ND	0.04
p,p'-DDE	ND	0.04
o,p'-DDT	ND	0.1
p,p'-DDT	ND	0.1
Dichlobenil	ND	0.3
Dichlone	ND	0.1
Dicloran	ND	0.1
Dicofol	ND	0.1
Dieldrin	ND	0.02
Dyrene	ND	1
Endosulfan alpha	ND	0.04
Endosulfan beta	ND	0.04
Endosulfan sulfate	ND	0.04
Endrin	ND	0.04
Ethafluralin	ND	0.1
Folpet	ND	0.1
Heptachlor	ND	0.03
Heptachlor epoxide	ND	0.05
Indoxacarb	ND	0.1
Iprodione	ND	0.1
Lindane (gamma-BHC)	ND	0.04
Linuron	ND	1
Methoxychlor	ND	1.7
Metribuzin	ND	0.05
Mirex	ND	0.05
Myclobutanil	ND	0.5
Oxadiazon	ND	0.1
Oxyfluorfen	ND	0.04
Pendimethalin	ND	0.02
Pentachloronitrobenzene (PCNB)	ND	0.04
Perthane	ND	0.1
Polychlorinated Biphenyls	ND	1.25
Profluralin	ND	0.1
Procymidone	ND	0.1
Pronamide	ND	0.2
Propiconazole	ND	1
Pyrethrins (Total)	ND	0.25
Tetradifon	ND	0.1
Toxaphene	ND	2.5
Triadimephon	ND	0.1
Triflumizole	ND	0.5
Trifloxystrobin	ND	0.1
Trifluralin	ND	0.1
Vegadex (Diethyldithiocarbamic Acid)	ND	0.1
Vinclozolin	ND	0.1

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Analytical Report

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Analyte	Amount µg/L	RL µg/L
Bifenthrin	ND	0.1
Cyfluthrin	ND	0.25
Cypermethrin	ND	0.25
Deltamethrin	ND	0.25
Esfenvalerate	ND	0.1
Fenpropathrin	ND	0.05
Fenvalerate	ND	0.2
Fluvalinate	ND	0.25
lambda Cyhalothrin	ND	0.05
Permethrin	ND	0.25

Client: Marc Beutel
UC Merced
5200 N. Lake Rd.
Merced , CA 95343
Phone: (209) 228-2229
Fax:
Email: mbeutel@ucmerced.edu

Project No: Newman Treatment Wetland

PO No:

Client Sample ID: Blank

Sample Date:
EMA Sample No: 19100117-00
Date Received: 10/1/2019
Sample Matrix: Water

Analytical Method: EPA 8081B (w) (Pyrethroids)
Extraction Method: EPA 3510
Date Extracted: 10/4/2019
Date Completed: 10/9/2019
Surrogate: Dibutylchlordenate
Surrogate Level: 0.4
% Recovery: 65.6

Comments:

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UC Merced
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Project No: Newman Treatment Wetland

PO No:

Client Sample ID: Blank

Sample Date:
EMA Sample No: 19100117-00
Date Received: 10/1/2019
Sample Matrix: Water

Analytical Method: EPA 8141B (w) (OP's)
Extraction Method: EPA 3510
Date Extracted: 10/4/2019
Date Completed: 10/10/2019

Surrogate: Triphenylphosphate
Surrogate Level: 2.0
% Recovery: 91.4

Comments:

Analyte	Amount µg/L	RL µg/L
Azinphos-methyl	ND	0.5
Bolstar	ND	0.5
Bensulide	ND	0.5
Carbofenothion	ND	2
Chlorfenvinphos	ND	0.5
Chlorpyrifos	ND	0.3
Chlorpyrifos-methyl	ND	0.3
Ciodrin	ND	0.5
Coumaphos	ND	1.5
DEF	ND	0.5
Demeton (Systox) O/S Analogues	ND	0.5
Diazinon	ND	0.5
Dibrom	ND	0.5
Dicrotophos	ND	0.5
Dimethoate	ND	0.5
Disulfoton	ND	0.3
EPN	ND	1
Ethion	ND	0.5
Ethoprop	ND	0.5
Fenamiphos	ND	0.5
Fenitrothion	ND	0.5
Fenthion	ND	0.5
Fonofos	ND	0.5
Imidan	ND	0.5
Isofenphos	ND	0.5
Malathion	ND	0.5
Methidathion	ND	0.5
Methyl Parathion	ND	0.5
Mevinphos	ND	0.5
Parathion	ND	0.5
Phorate	ND	0.5
Phosalone	ND	1.5
Phosphamidon	ND	1
Pyrimiphos-methyl	ND	0.5
Profenofos	ND	1
Propetamphos	ND	0.5
Ronnel	ND	0.5
Tetrachlorvinphos	ND	0.5
Thionazin	ND	0.5

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Project No: Newman Treatment Wetland

PO No:

Client Sample ID: Blank

Sample Date:
EMA Sample No: 19100117-00
Date Received: 10/1/2019
Sample Matrix: Water

Analytical Method: EPA 8141B (w) (ON's)
Extraction Method: EPA 3510
Date Extracted: 10/4/2019
Date Completed: 10/10/2019
Surrogate: Triphenylphosphate
Surrogate Level: 2.0
% Recovery: 91.4

Comments:

Analyte	Amount µg/L	RL µg/L
Acetamiprid	ND	2
Ametryn	ND	0.5
Atrazine	ND	0.5
Azoxystrobin	ND	0.5
Benthiocarb	ND	2
Cyanazine	ND	0.5
Cyprodinil	ND	0.5
Diphenyl Amine	ND	2
Hexazinone	ND	1
Imazalil	ND	2
Metalaxyl	ND	2
Metolachlor	ND	1
Metribuzin	ND	1
Molinate	ND	1
Myclobutanil	ND	0.5
Prometon	ND	0.5
Prometryne	ND	0.5
Pyraclostrobin	ND	0.5
Pymetrozine	ND	0.5
Simazine	ND	0.5
Tebuconazole	ND	0.5
Terbacil	ND	5
Thiabendazole	ND	1

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Analyte	Amount µg/L	RL µg/L

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UC Merced
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Merced , CA 95343
Phone: (209) 228-2229
Fax:
Email: mbeutel@ucmerced.edu

Project No: Newman Treatment Wetland

PO No:

Client Sample ID: Blank

Sample Date:
EMA Sample No: 19100117-00
Date Received: 10/1/2019
Sample Matrix: Water

Analytical Method: EPA 8318
Extraction Method: EPA 3510
Date Extracted: 10/4/2019
Date Completed: 10/10/2019

Surrogate:
Surrogate Level:
% Recovery:

Comments:

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ResultsID	Analyte/Species	Source	Site Code	Sample Date	Results	Units	Matrix	Method
5065746	Est Depth	Field	NWHFR	10-Sep-19		ft		
5065802	pH	Field	NWHFR	10-Sep-19	7.73			
5065690	DO	Field	NWHFR	10-Sep-19	5.37	mg/l		
5065718	EC	Field	NWHFR	10-Sep-19	1017	µmhos/cm		
5065774	Flow	Field	NWHFR	10-Sep-19		cfs		
5065830	Staff Gage	Field	NWHFR	10-Sep-19		ft		
5065858	Temp	Field	NWHFR	10-Sep-19	17.91	c		
5065768	Flow	Field	NWHFR	9-Sep-19		cfs		
5065740	Est Depth	Field	NWHFR	9-Sep-19		ft		
5065796	pH	Field	NWHFR	9-Sep-19	7.1			
5065684	DO	Field	NWHFR	9-Sep-19	5.2	mg/l		
5065712	EC	Field	NWHFR	9-Sep-19	976	µmhos/cm		
5065824	Staff Gage	Field	NWHFR	9-Sep-19		ft		
5065852	Temp	Field	NWHFR	9-Sep-19	18.56	c		
5064503	Est Depth	Field	NWHFR	13-Aug-19		ft		
5064563	Staff Gage	Field	NWHFR	13-Aug-19		ft		
5064583	Temp	Field	NWHFR	13-Aug-19	20.23	c		
5064463	DO	Field	NWHFR	13-Aug-19	5.11	mg/l		
5064483	EC	Field	NWHFR	13-Aug-19	769	µmhos/cm		
5064523	Flow	Field	NWHFR	13-Aug-19	43.1	cfs		
5064543	pH	Field	NWHFR	13-Aug-19	7.1			
5060778	Est Depth	Field	NWHFR	9-Jul-19		ft		
5060838	Staff Gage	Field	NWHFR	9-Jul-19		ft		
5060738	DO	Field	NWHFR	9-Jul-19	6.4	mg/l		
5060758	EC	Field	NWHFR	9-Jul-19	768	µmhos/cm		
5060798	Flow	Field	NWHFR	9-Jul-19	39.5	cfs		
5060818	pH	Field	NWHFR	9-Jul-19	6.88			
5060858	Temp	Field	NWHFR	9-Jul-19	19.96	c		
5058082	EC	Field	NWHFR	11-Jun-19	8.77	µmhos/cm		
5058060	DO	Field	NWHFR	11-Jun-19	4.26	mg/l		
5058104	Est Depth	Field	NWHFR	11-Jun-19		ft		
5058126	Flow	Field	NWHFR	11-Jun-19		cfs		
5058148	pH	Field	NWHFR	11-Jun-19	7.2			
5058170	Staff Gage	Field	NWHFR	11-Jun-19		ft		
5058192	Temp	Field	NWHFR	11-Jun-19	26.86	c		
5055385	Temp	Field	NWHFR	14-May-19	18.13	c		
5055275	EC	Field	NWHFR	14-May-19	979	µmhos/cm		
5055341	pH	Field	NWHFR	14-May-19	7.79			
5055319	Flow	Field	NWHFR	14-May-19		cfs		
5055297	Est Depth	Field	NWHFR	14-May-19		ft		
5055363	Staff Gage	Field	NWHFR	14-May-19		ft		
5055253	DO	Field	NWHFR	14-May-19	4.8	mg/l		
5052972	pH	Field	NWHFR	9-Apr-19	7.75			
5052951	Flow	Field	NWHFR	9-Apr-19	0	cfs		
5052993	Staff Gage	Field	NWHFR	9-Apr-19		ft		
5052909	EC	Field	NWHFR	9-Apr-19	1719	µmhos/cm		
5052888	DO	Field	NWHFR	9-Apr-19	4.43	mg/l		
5052930	Est Depth	Field	NWHFR	9-Apr-19		ft		
5053014	Temp	Field	NWHFR	9-Apr-19	17.16	c		
5051398	Est Depth	Field	NWHFR	12-Mar-19		ft		

5051503	Staff Gage	Field	NWHFR	12-Mar-19		ft		
5051468	pH	Field	NWHFR	12-Mar-19	8.06			
5051538	Temp	Field	NWHFR	12-Mar-19	13.25	c		
5051328	DO	Field	NWHFR	12-Mar-19	5.9	mg/l		
5051363	EC	Field	NWHFR	12-Mar-19	1157	µmhos/cm		
5051433	Flow	Field	NWHFR	12-Mar-19	0	cfs		
5051463	Flow	Field	NWHFR	11-Mar-19		cfs		
5051568	Temp	Field	NWHFR	11-Mar-19		c		
5051428	Est Depth	Field	NWHFR	11-Mar-19		ft		
5051498	pH	Field	NWHFR	11-Mar-19				
5051533	Staff Gage	Field	NWHFR	11-Mar-19		ft		
5051358	DO	Field	NWHFR	11-Mar-19		mg/l		
5051393	EC	Field	NWHFR	11-Mar-19		µmhos/cm		
5051173	EC	Field	NWHFR	14-Feb-19	1002	µmhos/cm		
5051278	Temp	Field	NWHFR	14-Feb-19	9.55	c		
5051194	Est Depth	Field	NWHFR	14-Feb-19		ft		
5051152	DO	Field	NWHFR	14-Feb-19	10.06	mg/l		
5051236	pH	Field	NWHFR	14-Feb-19	7.26			
5051215	Flow	Field	NWHFR	14-Feb-19		cfs		
5051257	Staff Gage	Field	NWHFR	14-Feb-19		ft		
5048996	pH	Field	NWHFR	17-Jan-19	8.05			
5048912	DO	Field	NWHFR	17-Jan-19	9.04	mg/l		
5049017	Staff Gage	Field	NWHFR	17-Jan-19		ft		
5048975	Flow	Field	NWHFR	17-Jan-19	43.9	cfs		
5048954	Est Depth	Field	NWHFR	17-Jan-19		ft		
5048933	EC	Field	NWHFR	17-Jan-19	579	µmhos/cm		
5049038	Temp	Field	NWHFR	17-Jan-19	11.84	c		
5047601	Est Depth	Field	NWHFR	30-Nov-18		ft		
5047685	Temp	Field	NWHFR	30-Nov-18	12.83	c		
5047664	Staff Gage	Field	NWHFR	30-Nov-18	0.25	ft		
5047643	pH	Field	NWHFR	30-Nov-18	7.63			
5047622	Flow	Field	NWHFR	30-Nov-18	306	cfs		
5047559	DO	Field	NWHFR	30-Nov-18	9.63	mg/l		
5047580	EC	Field	NWHFR	30-Nov-18	729	µmhos/cm		
5046219	EC	Field	NWHFR	9-Oct-18	1532	µmhos/cm		
5046282	pH	Field	NWHFR	9-Oct-18	7.31			
5046198	DO	Field	NWHFR	9-Oct-18	9.21	mg/l		
5046303	Staff Gage	Field	NWHFR	9-Oct-18		ft		
5046324	Temp	Field	NWHFR	9-Oct-18	14.25	c		
5046261	Flow	Field	NWHFR	9-Oct-18	15.9	cfs		
5046240	Est Depth	Field	NWHFR	9-Oct-18		ft		
5044182	DO	Field	NWHFR	11-Sep-18	6.68	mg/l		
5044357	Staff Gage	Field	NWHFR	11-Sep-18		ft		
5044217	EC	Field	NWHFR	11-Sep-18	1137	µmhos/cm		
5044252	Est Depth	Field	NWHFR	11-Sep-18		ft		
5044287	Flow	Field	NWHFR	11-Sep-18	19.7	cfs		
5044322	pH	Field	NWHFR	11-Sep-18	7.8			
5044392	Temp	Field	NWHFR	11-Sep-18	18.56	c		
5044376	Staff Gage	Field	NWHFR	10-Sep-18		ft		
5044201	DO	Field	NWHFR	10-Sep-18	7.04	mg/l		
5044236	EC	Field	NWHFR	10-Sep-18	998	µmhos/cm		

5044306	Flow	Field	NWHFR	10-Sep-18	18.6	cfs		
5044341	pH	Field	NWHFR	10-Sep-18	7.49			
5044411	Temp	Field	NWHFR	10-Sep-18	18.81	c		
5044271	Est Depth	Field	NWHFR	10-Sep-18		ft		
5043717	Staff Gage	Field	NWHFR	14-Aug-18		ft		
5043738	Temp	Field	NWHFR	14-Aug-18	21.38	c		
5043696	pH	Field	NWHFR	14-Aug-18	7.46			
5043675	Flow	Field	NWHFR	14-Aug-18	137	cfs		
5043654	Est Depth	Field	NWHFR	14-Aug-18		ft		
5043633	EC	Field	NWHFR	14-Aug-18	660	µmhos/cm		
5043612	DO	Field	NWHFR	14-Aug-18	8.5	mg/l		
5041721	Temp	Field	NWHFR	10-Jul-18	21.96	c		
5041700	Staff Gage	Field	NWHFR	10-Jul-18	0	ft		
5041679	pH	Field	NWHFR	10-Jul-18	7.58			
5041658	Flow	Field	NWHFR	10-Jul-18	15.6	cfs		
5041637	Est Depth	Field	NWHFR	10-Jul-18	0	ft		
5041616	EC	Field	NWHFR	10-Jul-18	923	µmhos/cm		
5041595	DO	Field	NWHFR	10-Jul-18	7.48	mg/l		
5041511	Flow	Field	NWHFR	12-Jun-18	65.8	cfs		
5041574	Temp	Field	NWHFR	12-Jun-18	21.04	c		
5041553	Staff Gage	Field	NWHFR	12-Jun-18	0	ft		
5041490	Est Depth	Field	NWHFR	12-Jun-18	0	ft		
5041448	DO	Field	NWHFR	12-Jun-18	7.2	mg/l		
5041532	pH	Field	NWHFR	12-Jun-18	7.78			
5041469	EC	Field	NWHFR	12-Jun-18	837	µmhos/cm		
5041364	Flow	Field	NWHFR	8-May-18	438	cfs		
5041427	Temp	Field	NWHFR	8-May-18	19.16	c		
5041301	DO	Field	NWHFR	8-May-18	5.13	mg/l		
5041343	Est Depth	Field	NWHFR	8-May-18	0	ft		
5041385	pH	Field	NWHFR	8-May-18	7.94			
5041406	Staff Gage	Field	NWHFR	8-May-18	0	ft		
5041322	EC	Field	NWHFR	8-May-18	749	µmhos/cm		
5041175	EC	Field	NWHFR	10-Apr-18	1724	µmhos/cm		
5041154	DO	Field	NWHFR	10-Apr-18	2.74	mg/l		
5041217	Flow	Field	NWHFR	10-Apr-18	1	cfs		
5041238	pH	Field	NWHFR	10-Apr-18	8.06			
5041259	Staff Gage	Field	NWHFR	10-Apr-18	0	ft		
5041280	Temp	Field	NWHFR	10-Apr-18	19.08	c		
5041196	Est Depth	Field	NWHFR	10-Apr-18	0	ft		
5041072	EC	Field	NWHFR	12-Mar-18	1928	µmhos/cm		
5041059	DO	Field	NWHFR	12-Mar-18	3.18	mg/l		
5041137	Temp	Field	NWHFR	12-Mar-18	14.34	c		
5041124	Staff Gage	Field	NWHFR	12-Mar-18	0	ft		
5041111	pH	Field	NWHFR	12-Mar-18	7.28			
5041098	Flow	Field	NWHFR	12-Mar-18	0	cfs		
5041085	Est Depth	Field	NWHFR	12-Mar-18	0	ft		
5040979	Flow	Field	NWHFR	2-Mar-18	286.3	cfs		
5041000	pH	Field	NWHFR	2-Mar-18	7.64			
5041021	Staff Gage	Field	NWHFR	2-Mar-18	0	ft		
5041042	Temp	Field	NWHFR	2-Mar-18	11.54	c		
5040958	Est Depth	Field	NWHFR	2-Mar-18	0	ft		

5040916	DO	Field	NWHFR	2-Mar-18	6.26	mg/l		
5040937	EC	Field	NWHFR	2-Mar-18	775	µmhos/cm		
5038717	DO	Field	NWHFR	13-Feb-18	8.17	mg/l		
5038738	EC	Field	NWHFR	13-Feb-18	2165	µmhos/cm		
5038759	Est Depth	Field	NWHFR	13-Feb-18	0	ft		
5038780	Flow	Field	NWHFR	13-Feb-18	0	cfs		
5038801	pH	Field	NWHFR	13-Feb-18	7.37			
5038843	Temp	Field	NWHFR	13-Feb-18	9.16	c		
5038822	Staff Gage	Field	NWHFR	13-Feb-18	0	ft		
5038654	pH	Field	NWHFR	9-Jan-18				
5038570	DO	Field	NWHFR	9-Jan-18		mg/l		
5038696	Temp	Field	NWHFR	9-Jan-18		c		
5038675	Staff Gage	Field	NWHFR	9-Jan-18	0	ft		
5038633	Flow	Field	NWHFR	9-Jan-18	0	cfs		
5038612	Est Depth	Field	NWHFR	9-Jan-18	0	ft		
5038591	EC	Field	NWHFR	9-Jan-18		µmhos/cm		
5028188	Staff Gage	Field	NWHFR	10-Oct-17		ft		
5028167	pH	Field	NWHFR	10-Oct-17	7.57			
5028146	Flow	Field	NWHFR	10-Oct-17	34.29	cfs		
5028125	Est Depth	Field	NWHFR	10-Oct-17		ft		
5028104	EC	Field	NWHFR	10-Oct-17	1132	µmhos/cm		
5028083	DO	Field	NWHFR	10-Oct-17		mg/l		
5028209	Temp	Field	NWHFR	10-Oct-17	14.76	c		
5027100	Staff Gage	Field	NWHFR	12-Sep-17		ft		
5026964	EC	Field	NWHFR	12-Sep-17	710	µmhos/cm		
5027134	Temp	Field	NWHFR	12-Sep-17	24.8	c		
5026930	DO	Field	NWHFR	12-Sep-17	9.22	mg/l		
5027066	pH	Field	NWHFR	12-Sep-17	7.45			
5027032	Flow	Field	NWHFR	12-Sep-17	525	cfs		
5026998	Est Depth	Field	NWHFR	12-Sep-17		ft		
5026986	EC	Field	NWHFR	11-Sep-17	815	µmhos/cm		
5027156	Temp	Field	NWHFR	11-Sep-17	25.22	c		
5027122	Staff Gage	Field	NWHFR	11-Sep-17		ft		
5027088	pH	Field	NWHFR	11-Sep-17	6.85			
5027054	Flow	Field	NWHFR	11-Sep-17	447	cfs		
5027020	Est Depth	Field	NWHFR	11-Sep-17		ft		
5026952	DO	Field	NWHFR	11-Sep-17	7.15	mg/l		
5022846	Staff Gage	Field	NWHFR	8-Aug-17		ft		
5022741	DO	Field	NWHFR	8-Aug-17		mg/l		
5022762	EC	Field	NWHFR	8-Aug-17		µmhos/cm		
5022783	Est Depth	Field	NWHFR	8-Aug-17		ft		
5022825	pH	Field	NWHFR	8-Aug-17				
5022867	Temp	Field	NWHFR	8-Aug-17		c		
5022804	Flow	Field	NWHFR	8-Aug-17		cfs		
5017064	pH	Field	NWHFR	11-Jul-17				
5017044	Flow	Field	NWHFR	11-Jul-17		cfs		
5017024	Est Depth	Field	NWHFR	11-Jul-17		ft		
5017004	EC	Field	NWHFR	11-Jul-17		µmhos/cm		
5016984	DO	Field	NWHFR	11-Jul-17		mg/l		
5017084	Staff Gage	Field	NWHFR	11-Jul-17		ft		
5017104	Temp	Field	NWHFR	11-Jul-17		c		

5016933	pH	Field	NWHFR	13-Jun-17	7.49			
5016975	Temp	Field	NWHFR	13-Jun-17	22.19	c		
5016954	Staff Gage	Field	NWHFR	13-Jun-17		ft		
5016849	DO	Field	NWHFR	13-Jun-17	7.25	mg/l		
5016870	EC	Field	NWHFR	13-Jun-17	839	µmhos/cm		
5016891	Est Depth	Field	NWHFR	13-Jun-17		ft		
5016912	Flow	Field	NWHFR	13-Jun-17	0	cfs		
5016691	DO	Field	NWHFR	9-May-17	8.64	mg/l		
5016712	EC	Field	NWHFR	9-May-17	844	µmhos/cm		
5016733	Est Depth	Field	NWHFR	9-May-17		ft		
5016754	Flow	Field	NWHFR	9-May-17	0	cfs		
5016775	pH	Field	NWHFR	9-May-17	7.45			
5016796	Staff Gage	Field	NWHFR	9-May-17		ft		
5016817	Temp	Field	NWHFR	9-May-17	23.19	c		
5015907	DO	Field	NWHFR	11-Apr-17	7	mg/l		
5016033	Temp	Field	NWHFR	11-Apr-17	17.98	c		
5016012	Staff Gage	Field	NWHFR	11-Apr-17		ft		
5015991	pH	Field	NWHFR	11-Apr-17	7.44			
5015970	Flow	Field	NWHFR	11-Apr-17		cfs		
5015949	Est Depth	Field	NWHFR	11-Apr-17		ft		
5015928	EC	Field	NWHFR	11-Apr-17	804	µmhos/cm		
5015697	EC	Field	NWHFR	14-Mar-17	610	µmhos/cm		
5015867	Temp	Field	NWHFR	14-Mar-17	18.21	c		
5015799	pH	Field	NWHFR	14-Mar-17	7.22			
5015783	Flow	Field	NWHFR	14-Mar-17		cfs		
5015663	DO	Field	NWHFR	14-Mar-17	5.58	mg/l		
5015833	Staff Gage	Field	NWHFR	13-Mar-17		ft		
5015885	Temp	Field	NWHFR	13-Mar-17		c		
5015851	Staff Gage	Field	NWHFR	13-Mar-17		ft		
5015817	pH	Field	NWHFR	13-Mar-17				
5015765	Flow	Field	NWHFR	13-Mar-17		cfs		
5015749	Est Depth	Field	NWHFR	13-Mar-17		ft		
5015731	Est Depth	Field	NWHFR	13-Mar-17		ft		
5015715	EC	Field	NWHFR	13-Mar-17		µmhos/cm		
5015681	DO	Field	NWHFR	13-Mar-17		mg/l		
5006548	Temp	Field	NWHFR	14-Feb-17	13.63	c		
5006463	EC	Field	NWHFR	14-Feb-17	377	µmhos/cm		
5006497	Flow	Field	NWHFR	14-Feb-17		cfs		
5006531	Staff Gage	Field	NWHFR	14-Feb-17		ft		
5006480	Est Depth	Field	NWHFR	14-Feb-17		ft		
5006446	DO	Field	NWHFR	14-Feb-17	10.81	mg/l		
5006514	pH	Field	NWHFR	14-Feb-17	7.42			
5003938	Flow	Field	NWHFR	10-Jan-17	0	cfs		
5003894	EC	Field	NWHFR	10-Jan-17	989	µmhos/cm		
5004004	Temp	Field	NWHFR	10-Jan-17	10.92	c		
5003960	pH	Field	NWHFR	10-Jan-17	7.28			
5003916	Est Depth	Field	NWHFR	10-Jan-17		ft		
5003872	DO	Field	NWHFR	10-Jan-17	6.57	mg/l		
5003982	Staff Gage	Field	NWHFR	10-Jan-17		ft		
5002679	Temp	Field	NWHFR	1-Nov-16	15.34	c		
5002658	Staff Gage	Field	NWHFR	1-Nov-16		ft		

5002637	pH	Field	NWHFR	1-Nov-16	2.41			
5002616	Flow	Field	NWHFR	1-Nov-16	102	cfs		
5002595	Est Depth	Field	NWHFR	1-Nov-16		ft		
5002574	EC	Field	NWHFR	1-Nov-16	1219	µmhos/cm		
5002553	DO	Field	NWHFR	1-Nov-16	4.94	mg/l		
4999216	Temp	Field	NWHFR	11-Oct-16	15.67	c		
4999114	DO	Field	NWHFR	11-Oct-16	5.71	mg/l		
4999131	EC	Field	NWHFR	11-Oct-16	982	µmhos/cm		
4999148	Est Depth	Field	NWHFR	11-Oct-16		ft		
4999165	Flow	Field	NWHFR	11-Oct-16	437	cfs		
4999199	Staff Gage	Field	NWHFR	11-Oct-16		ft		
4999182	pH	Field	NWHFR	11-Oct-16	7.57			
4998266	EC	Field	NWHFR	13-Sep-16	1236	µmhos/cm		
4998416	Temp	Field	NWHFR	13-Sep-16	16.52	c		
4998386	Staff Gage	Field	NWHFR	13-Sep-16		ft		
4998356	pH	Field	NWHFR	13-Sep-16	7.62			
4998296	Est Depth	Field	NWHFR	13-Sep-16		ft		
4998236	DO	Field	NWHFR	13-Sep-16	5.63	mg/l		
4998326	Flow	Field	NWHFR	13-Sep-16	455	cfs		
4998334	Flow	Field	NWHFR	12-Sep-16	257.73	cfs		
4998274	EC	Field	NWHFR	12-Sep-16	1219	µmhos/cm		
4998424	Temp	Field	NWHFR	12-Sep-16	18.95	c		
4998304	Est Depth	Field	NWHFR	12-Sep-16		ft		
4998394	Staff Gage	Field	NWHFR	12-Sep-16		ft		
4998364	pH	Field	NWHFR	12-Sep-16	7.26			
4998244	DO	Field	NWHFR	12-Sep-16	4.27	mg/l		
4995590	Staff Gage	Field	NWHFR	9-Aug-16		ft		
4995610	Temp	Field	NWHFR	9-Aug-16	20.37	c		
4995570	pH	Field	NWHFR	9-Aug-16	7.78			
4995490	DO	Field	NWHFR	9-Aug-16	4.41	mg/l		
4995550	Flow	Field	NWHFR	9-Aug-16	389	cfs		
4995530	Est Depth	Field	NWHFR	9-Aug-16		ft		
4995510	EC	Field	NWHFR	9-Aug-16	1035	µmhos/cm		
4992673	DO	Field	NWHFR	12-Jul-16	8.96	mg/l		
4992733	Flow	Field	NWHFR	12-Jul-16	136	cfs		
4992713	Est Depth	Field	NWHFR	12-Jul-16		ft		
4992753	pH	Field	NWHFR	12-Jul-16	7.52			
4992773	Staff Gage	Field	NWHFR	12-Jul-16		ft		
4992693	EC	Field	NWHFR	12-Jul-16	1260	µmhos/cm		
4992793	Temp	Field	NWHFR	12-Jul-16	20.27	c		
4991403	DO	Field	NWHFR	14-Jun-16	3.84	mg/l		
4991529	Temp	Field	NWHFR	14-Jun-16	19.78	c		
4991508	Staff Gage	Field	NWHFR	14-Jun-16		ft		
4991487	pH	Field	NWHFR	14-Jun-16	7.42			
4991466	Flow	Field	NWHFR	14-Jun-16	124.5	cfs		
4991445	Est Depth	Field	NWHFR	14-Jun-16		ft		
4991424	EC	Field	NWHFR	14-Jun-16	1242	µmhos/cm		
4991082	EC	Field	NWHFR	10-May-16	1502	µmhos/cm		
4991282	Staff Gage	Field	NWHFR	10-May-16		ft		
4991132	Est Depth	Field	NWHFR	10-May-16		ft		
4991332	Temp	Field	NWHFR	10-May-16	19.04	c		

4991182	Flow	Field	NWHFR	10-May-16	121	cfs		
4991032	DO	Field	NWHFR	10-May-16	2.62	mg/l		
4991232	pH	Field	NWHFR	10-May-16	7.25			
4991103	Est Depth	Field	NWHFR	12-Apr-16		ft		
4991153	Flow	Field	NWHFR	12-Apr-16	270	cfs		
4991253	Staff Gage	Field	NWHFR	12-Apr-16		ft		
4991203	pH	Field	NWHFR	12-Apr-16	7.2			
4991303	Temp	Field	NWHFR	12-Apr-16	17.4	c		
4991053	EC	Field	NWHFR	12-Apr-16	1285	µmhos/cm		
4991003	DO	Field	NWHFR	12-Apr-16	5.43	mg/l		
4988253	Staff Gage	Field	NWHFR	8-Mar-16		ft		
4988153	EC	Field	NWHFR	8-Mar-16	711	µmhos/cm		
4988278	Temp	Field	NWHFR	8-Mar-16	12.04	c		
4988228	pH	Field	NWHFR	8-Mar-16	7.23			
4988203	Flow	Field	NWHFR	8-Mar-16	69	cfs		
4988128	DO	Field	NWHFR	8-Mar-16	2.04	mg/l		
4988178	Est Depth	Field	NWHFR	8-Mar-16		ft		
4988124	DO	Field	NWHFR	7-Mar-16	4.96	mg/l		
4988274	Temp	Field	NWHFR	7-Mar-16	12.61	c		
4988224	pH	Field	NWHFR	7-Mar-16	7.22			
4988199	Flow	Field	NWHFR	7-Mar-16	0	cfs		
4988249	Staff Gage	Field	NWHFR	7-Mar-16		ft		
4988174	Est Depth	Field	NWHFR	7-Mar-16		ft		
4988149	EC	Field	NWHFR	7-Mar-16	634	µmhos/cm		
4985663	DO	Field	NWHFR	9-Feb-16	2.31	mg/l		
4985680	EC	Field	NWHFR	9-Feb-16	2399	µmhos/cm		
4985714	Flow	Field	NWHFR	9-Feb-16	61	cfs		
4985731	pH	Field	NWHFR	9-Feb-16	7.25			
4985748	Staff Gage	Field	NWHFR	9-Feb-16		ft		
4985765	Temp	Field	NWHFR	9-Feb-16	8.65	c		
4985697	Est Depth	Field	NWHFR	9-Feb-16		ft		
4984558	pH	Field	NWHFR	7-Jan-16	7.3			
4984579	Staff Gage	Field	NWHFR	7-Jan-16		ft		
4984495	EC	Field	NWHFR	7-Jan-16	7.32	µmhos/cm		
4984516	Est Depth	Field	NWHFR	7-Jan-16		ft		
4984537	Flow	Field	NWHFR	7-Jan-16	502	cfs		
4984474	DO	Field	NWHFR	7-Jan-16	5.53	mg/l		
4984600	Temp	Field	NWHFR	7-Jan-16	9.2	c		
4983410	Flow	Field	NWHFR	20-Oct-15	116	cfs		
4983356	DO	Field	NWHFR	20-Oct-15	6.06	mg/l		
4983392	Est Depth	Field	NWHFR	20-Oct-15		ft		
4983428	pH	Field	NWHFR	20-Oct-15	7.39			
4983446	Staff Gage	Field	NWHFR	20-Oct-15		ft		
4983464	Temp	Field	NWHFR	20-Oct-15	14.4	c		
4983374	EC	Field	NWHFR	20-Oct-15	2408	µmhos/cm		
4981218	pH	Field	NWHFR	15-Sep-15	7.58			
4981190	Est Depth	Field	NWHFR	15-Sep-15		ft		
4981162	DO	Field	NWHFR	15-Sep-15	3.18	mg/l		
4981246	Temp	Field	NWHFR	15-Sep-15	19.13	c		
4981204	Flow	Field	NWHFR	15-Sep-15	101	cfs		
4981176	EC	Field	NWHFR	15-Sep-15	1423	µmhos/cm		

4981232	Staff Gage	Field	NWHFR	15-Sep-15		ft		
4981172	EC	Field	NWHFR	14-Sep-15	1441	µmhos/cm		
4981158	DO	Field	NWHFR	14-Sep-15	3.65	mg/l		
4981186	Est Depth	Field	NWHFR	14-Sep-15		ft		
4981200	Flow	Field	NWHFR	14-Sep-15	101	cfs		
4981228	Staff Gage	Field	NWHFR	14-Sep-15		ft		
4981242	Temp	Field	NWHFR	14-Sep-15	19.61	c		
4981214	pH	Field	NWHFR	14-Sep-15	7.36			
4979840	Temp	Field	NWHFR	11-Aug-15	20.06	c		
4979829	Staff Gage	Field	NWHFR	11-Aug-15		ft		
4979818	pH	Field	NWHFR	11-Aug-15	7.82			
4979807	Flow	Field	NWHFR	11-Aug-15	179	cfs		
4979796	Est Depth	Field	NWHFR	11-Aug-15		ft		
4979785	EC	Field	NWHFR	11-Aug-15	1305	µmhos/cm		
4979774	DO	Field	NWHFR	11-Aug-15	3.49	mg/l		
4978305	Temp	Field	NWHFR	14-Jul-15	20.88	c		
4978185	DO	Field	NWHFR	14-Jul-15	3.02	mg/l		
4978265	pH	Field	NWHFR	14-Jul-15	7.32			
4978245	Flow	Field	NWHFR	14-Jul-15	3	cfs		
4978205	EC	Field	NWHFR	14-Jul-15	1427	µmhos/cm		
4978285	Staff Gage	Field	NWHFR	14-Jul-15		ft		
4978225	Est Depth	Field	NWHFR	14-Jul-15		ft		
4974686	DO	Field	NWHFR	9-Jun-15	2.9	mg/l		
4974740	Temp	Field	NWHFR	9-Jun-15	22.26	c		
4974731	Staff Gage	Field	NWHFR	9-Jun-15		ft		
4974722	pH	Field	NWHFR	9-Jun-15	7.34			
4974713	Flow	Field	NWHFR	9-Jun-15	137	cfs		
4974704	Est Depth	Field	NWHFR	9-Jun-15		ft		
4974695	EC	Field	NWHFR	9-Jun-15	1795	µmhos/cm		
4972815	DO	Field	NWHFR	12-May-15	5.54	mg/l		
4972935	Temp	Field	NWHFR	12-May-15	15.81	c		
4972915	Staff Gage	Field	NWHFR	12-May-15		ft		
4972895	pH	Field	NWHFR	12-May-15	7.51			
4972875	Flow	Field	NWHFR	12-May-15	26.14	cfs		
4972855	Est Depth	Field	NWHFR	12-May-15		ft		
4972835	EC	Field	NWHFR	12-May-15	1904	µmhos/cm		
4970946	Flow	Field	NWHFR	14-Apr-15	17.82	cfs		
4970973	Temp	Field	NWHFR	14-Apr-15	13.35	c		
4970955	pH	Field	NWHFR	14-Apr-15	7.71			
4970937	Est Depth	Field	NWHFR	14-Apr-15		ft		
4970928	EC	Field	NWHFR	14-Apr-15	2401	µmhos/cm		
4970919	DO	Field	NWHFR	14-Apr-15	6.08	mg/l		
4970964	Staff Gage	Field	NWHFR	14-Apr-15		ft		
4969121	DO	Field	NWHFR	10-Mar-15	3.75	mg/l		
4969175	Temp	Field	NWHFR	10-Mar-15	13.48	c		
4969166	Staff Gage	Field	NWHFR	10-Mar-15	0	ft		
4969157	pH	Field	NWHFR	10-Mar-15	7.42			
4969148	Flow	Field	NWHFR	10-Mar-15	47.7	cfs		
4969139	Est Depth	Field	NWHFR	10-Mar-15	0.5	ft		
4969130	EC	Field	NWHFR	10-Mar-15	1680	µmhos/cm		
4969025	Flow	Field	NWHFR	9-Mar-15	3	cfs		

4969037	Temp	Field	NWHFR	9-Mar-15	14.16	c		
4969033	Staff Gage	Field	NWHFR	9-Mar-15	0	ft		
4969029	pH	Field	NWHFR	9-Mar-15	7.49			
4969021	Est Depth	Field	NWHFR	9-Mar-15	0	ft		
4969013	DO	Field	NWHFR	9-Mar-15	4.51	mg/l		
4969017	EC	Field	NWHFR	9-Mar-15	1929	µmhos/cm		
4968844	EC	Field	NWHFR	10-Feb-15	1254	µmhos/cm		
4968843	DO	Field	NWHFR	10-Feb-15	4.08	mg/l		
4968845	Est Depth	Field	NWHFR	10-Feb-15	0.5	ft		
4968847	pH	Field	NWHFR	10-Feb-15	7.32			
4968848	Staff Gage	Field	NWHFR	10-Feb-15	0	ft		
4968849	Temp	Field	NWHFR	10-Feb-15	13.21	c		
4968846	Flow	Field	NWHFR	10-Feb-15	275.4	cfs		
4964744	Temp	Field	NWHFR	13-Jan-15	9.8	c		
4964708	Est Depth	Field	NWHFR	13-Jan-15	0.6	ft		
4964690	DO	Field	NWHFR	13-Jan-15	6.08	mg/l		
4964699	EC	Field	NWHFR	13-Jan-15	2512	µmhos/cm		
4964717	Flow	Field	NWHFR	13-Jan-15	20.79	cfs		
4964735	Staff Gage	Field	NWHFR	13-Jan-15		ft		
4964726	pH	Field	NWHFR	13-Jan-15	7.67			

ResultsID	Analyte/Species	Source	Sample ID	Site Code	Sample Date	Time Sampled	Results	Units
5067540	Ammonia as N	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	-0.04	mg/L
5065423	Ammonia as N	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	-0.04	mg/L
5064758	Ammonia as N	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	0.076	mg/L
5062087	Ammonia as N	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	-0.04	mg/L
5060136	Ammonia as N	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	0.46	mg/L
5055676	Ammonia as N	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	0.37	mg/L
5054085	Ammonia as N	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	0.43	mg/L
5052120	Ammonia as N	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	0.083	mg/L
5051008	Ammonia as N	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	0.32	mg/L
5048510	Ammonia as N	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	0.21	mg/L
5047494	Ammonia as N	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	-0.04	mg/L
5045128	Ammonia as N	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	-0.04	mg/L
5043998	Ammonia as N	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	0.088	mg/L
5043425	Ammonia as N	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	0.19	mg/L
5043005	Ammonia as N	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	0.32	mg/L
5037794	Ammonia as N	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	0.32	mg/L
5037410	Ammonia as N	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	0.14	mg/L
5042127	Ammonia as N	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	0.52	mg/L
5036528	Ammonia as N	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	0.15	mg/L
5027487	Ammonia as N	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		0.19	mg/L
5026572	Ammonia as N	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	0.099	mg/L
5020857	Ammonia as N	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	0.57	mg/L
5018990	Ammonia as N	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	1.1	mg/L
5016468	Ammonia as N	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	0.16	mg/L
5008234	Ammonia as N	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	0.34	mg/L
5009096	Ammonia as N	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	0.21	mg/L
5006604	Ammonia as N	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	0.34	mg/L
5004593	Ammonia as N	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	0.27	mg/L
5001254	Ammonia as N	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	0.12	mg/L
5000592	Ammonia as N	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	0.11	mg/L
4999545	Ammonia as N	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	0.22	mg/L
4997036	Ammonia as N	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	0.2	mg/L
4995222	Ammonia as N	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	0.23	mg/L
4994045	Ammonia as N	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	0.21	mg/L
4994721	Ammonia as N	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	0.21	mg/L
4989963	Ammonia as N	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	0.12	mg/L
4987871	Ammonia as N	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	0.077	mg/L
4985870	Ammonia as N	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	0.11	mg/L
4987142	Ammonia as N	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	0.21	mg/L
4984399	Ammonia as N	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	0.055	mg/L
4982933	Ammonia as N	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	0.077	mg/L
4981008	Ammonia as N	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	0.11	mg/L
4979576	Ammonia as N	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	0.2	mg/L
4976875	Ammonia as N	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	0.22	mg/L
4975065	Ammonia as N	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	0.16	mg/L
4973190	Ammonia as N	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	0.13	mg/L
4970695	Ammonia as N	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	0.14	mg/L
4968696	Ammonia as N	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	0.45	mg/L
4967695	Ammonia as N	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	0.099	mg/L
5067466	Arsenic	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	2	ug/L
5065210	Arsenic	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	1.6	ug/L
5064638	Arsenic	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	1.5	ug/L
5061874	Arsenic	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	3.3	ug/L
5060030	Arsenic	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	3.2	ug/L
5055459	Arsenic	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	3.3	ug/L
5054224	Arsenic	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	2.6	ug/L
5052154	Arsenic	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	1.8	ug/L
5050911	Arsenic	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	2.5	ug/L
5048578	Arsenic	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	2.2	ug/L
5047353	Arsenic	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	2.3	ug/L
5044996	Arsenic	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	2.1	ug/L
5043951	Arsenic	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	2.8	ug/L
5043323	Arsenic	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	2.2	ug/L
5042822	Arsenic	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	3.2	ug/L
5037721	Arsenic	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	2.3	ug/L
5037351	Arsenic	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	5.3	ug/L
5041795	Arsenic	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	2.8	ug/L
5036225	Arsenic	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	2.6	ug/L
5027227	Arsenic	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		1.6	ug/L
5026263	Arsenic	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	2.5	ug/L
5020713	Arsenic	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	4.2	ug/L
5018677	Arsenic	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	7.3	ug/L

5016141	Arsenic	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	4.7	ug/L
5007700	Arsenic	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	3.2	ug/L
5008708	Arsenic	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	2.8	ug/L
5004325	Arsenic	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	2.3	ug/L
5001127	Arsenic	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	2.4	ug/L
4987550	Arsenic	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	1.7	ug/L
4986901	Arsenic	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	1.5	ug/L
4968217	Arsenic	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	2.6	ug/L
4967452	Arsenic	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	1.6	ug/L
5067467	Boron	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	500	ug/L
5065211	Boron	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	453	ug/L
5064639	Boron	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	440	ug/L
5061957	Boron	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	150	ug/L
5060031	Boron	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	470	ug/L
5055460	Boron	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	920	ug/L
5054225	Boron	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	470	ug/L
5052155	Boron	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	380	ug/L
5050912	Boron	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	330	ug/L
5048579	Boron	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	340	ug/L
5047354	Boron	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	760	ug/L
5044997	Boron	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	460	ug/L
5043952	Boron	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	320	ug/L
5043324	Boron	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	490	ug/L
5042823	Boron	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	410	ug/L
5037722	Boron	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	370	ug/L
5037352	Boron	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	930	ug/L
5041796	Boron	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	430	ug/L
5036226	Boron	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	1200	ug/L
5027228	Boron	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		620	ug/L
5026264	Boron	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	360	ug/L
5020714	Boron	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	290	ug/L
5018678	Boron	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	450	ug/L
5016142	Boron	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	470	ug/L
5007701	Boron	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	410	ug/L
5008709	Boron	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	410	ug/L
5004326	Boron	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	330	ug/L
5001128	Boron	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	610	ug/L
4987551	Boron	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	420	ug/L
4986902	Boron	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	350	ug/L
4968218	Boron	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	620	ug/L
4967453	Boron	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	1400	ug/L
5036734	Bromide	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	0.68	mg/L
5027737	Bromide	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		0.39	mg/L
5026802	Bromide	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	0.38	mg/L
5021035	Bromide	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	-0.2	mg/L
5019179	Bromide	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	-0.2	mg/L
5016652	Bromide	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	0.29	mg/L
5008389	Bromide	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	0.24	mg/L
5009235	Bromide	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	0.2	mg/L
5007112	Bromide	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	-0.2	mg/L
5004627	Bromide	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	0.26	mg/L
5000873	Bromide	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	0.36	mg/L
5000572	Bromide	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	0.44	mg/L
4999466	Bromide	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	0.45	mg/L
4997108	Bromide	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	0.38	mg/L
4995412	Bromide	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	0.42	mg/L
4994115	Bromide	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	0.43	mg/L
4994885	Bromide	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	0.54	mg/L
4990110	Bromide	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	-0.2	mg/L
4988054	Bromide	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	-0.2	mg/L
4986010	Bromide	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	0.44	mg/L
4987312	Bromide	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	-0.2	mg/L
4984280	Bromide	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	0.41	mg/L
4983080	Bromide	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	0.29	mg/L
4981130	Bromide	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	0.38	mg/L
4979757	Bromide	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	0.41	mg/L
4977066	Bromide	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	0.57	mg/L
4975281	Bromide	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	0.57	mg/L
4973475	Bromide	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	0.85	mg/L
4970843	Bromide	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	0.59	mg/L
4968547	Bromide	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	0.43	mg/L
4967893	Bromide	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	0.77	mg/L
5065341	Cadmium	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	-0.05	ug/L

5064912	Cadmium	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	-0.05	ug/L
5061986	Cadmium	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	-0.05	ug/L
5060085	Cadmium	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	-0.05	ug/L
5055603	Cadmium	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	-0.05	ug/L
5054391	Cadmium	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	-0.05	ug/L
5052028	Cadmium	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	-0.05	ug/L
5050822	Cadmium	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	-0.05	ug/L
5041969	Cadmium	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	-0.05	ug/L
5036227	Cadmium	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	-0.05	ug/L
5027229	Cadmium	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		-0.05	ug/L
5026265	Cadmium	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	-0.05	ug/L
5020715	Cadmium	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	-0.05	ug/L
5018679	Cadmium	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	0.13	ug/L
5016143	Cadmium	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	0.1	ug/L
5007702	Cadmium	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	0.09	ug/L
5008710	Cadmium	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	-0.05	ug/L
5004327	Cadmium	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	0.09	ug/L
5001129	Cadmium	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	-0.05	ug/L
4987552	Cadmium	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	-0.05	ug/L
4986903	Cadmium	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	-0.05	ug/L
4968219	Cadmium	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	-0.05	ug/L
4967454	Cadmium	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	0.09	ug/L
5036430	Cadmium (Dissolved)	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	-0.05	ug/L
5027834	Cadmium (Dissolved)	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		-0.05	ug/L
5026484	Cadmium (Dissolved)	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	-0.05	ug/L
5020588	Cadmium (Dissolved)	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	-0.05	ug/L
5018882	Cadmium (Dissolved)	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	-0.05	ug/L
5016359	Cadmium (Dissolved)	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	-0.05	ug/L
5008003	Cadmium (Dissolved)	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	-0.05	ug/L
5008926	Cadmium (Dissolved)	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	-0.05	ug/L
5004228	Cadmium (Dissolved)	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	-0.05	ug/L
5001198	Cadmium (Dissolved)	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	-0.05	ug/L
4987764	Cadmium (Dissolved)	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	-0.05	ug/L
4987050	Cadmium (Dissolved)	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	-0.05	ug/L
4968265	Cadmium (Dissolved)	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	-0.05	ug/L
4967621	Cadmium (Dissolved)	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	0.07	ug/L
5065342	Copper	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	0.65	ug/L
5064913	Copper	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	0.67	ug/L
5061987	Copper	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	0.7	ug/L
5060086	Copper	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	0.41	ug/L
5055604	Copper	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	0.47	ug/L
5054392	Copper	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	1.9	ug/L
5052029	Copper	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	1.9	ug/L
5050823	Copper	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	2.2	ug/L
5048496	Copper	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	3	ug/L
5047308	Copper	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	0.43	ug/L
5045091	Copper	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	0.95	ug/L
5043889	Copper	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	1.2	ug/L
5043237	Copper	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	0.72	ug/L
5042892	Copper	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	1.1	ug/L
5037640	Copper	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	0.54	ug/L
5037283	Copper	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	1.2	ug/L
5041970	Copper	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	1.8	ug/L
5036228	Copper	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	1.8	ug/L
5027230	Copper	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		1.6	ug/L
5026266	Copper	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	2.2	ug/L
5020716	Copper	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	3.6	ug/L
5018680	Copper	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	11	ug/L
5016299	Copper	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	2.1	ug/L
5007703	Copper	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	1.7	ug/L
5008711	Copper	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	3	ug/L
5004328	Copper	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	5.9	ug/L
5001130	Copper	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	2.8	ug/L
4987553	Copper	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	2.7	ug/L
4986904	Copper	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	4	ug/L
4968220	Copper	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	8	ug/L
4967455	Copper	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	1.6	ug/L
5036431	Copper (Dissolved)	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	0.67	ug/L
5027835	Copper (Dissolved)	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		0.48	ug/L
5026485	Copper (Dissolved)	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	1.4	ug/L
5020589	Copper (Dissolved)	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	0.68	ug/L
5018883	Copper (Dissolved)	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	1.1	ug/L
5016360	Copper (Dissolved)	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	0.6	ug/L

5008004	Copper (Dissolved)	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	0.99	ug/L
5008927	Copper (Dissolved)	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	1.1	ug/L
5004229	Copper (Dissolved)	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	2.1	ug/L
5001199	Copper (Dissolved)	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	1.6	ug/L
4987765	Copper (Dissolved)	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	1.2	ug/L
4987051	Copper (Dissolved)	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	1.9	ug/L
4968266	Copper (Dissolved)	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	2	ug/L
4967622	Copper (Dissolved)	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	0.495	ug/L
5067701	Dissolved Organic Carl	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	3.9	mg/L
5065493	Dissolved Organic Carl	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	3.5	mg/L
5065003	Dissolved Organic Carl	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	4.8	mg/L
5062167	Dissolved Organic Carl	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	5.5	mg/L
5060252	Dissolved Organic Carl	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	5	mg/L
5055751	Dissolved Organic Carl	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	8.2	mg/L
5054187	Dissolved Organic Carl	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	9.1	mg/L
5052314	Dissolved Organic Carl	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	4.8	mg/L
5051013	Dissolved Organic Carl	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	5.7	mg/L
5048638	Dissolved Organic Carl	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	8.2	mg/L
5047394	Dissolved Organic Carl	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	3.5	mg/L
5045156	Dissolved Organic Carl	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	3.8	mg/L
5044073	Dissolved Organic Carl	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	5.8	mg/L
5043510	Dissolved Organic Carl	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	4.8	mg/L
5042859	Dissolved Organic Carl	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	5.4	mg/L
5037888	Dissolved Organic Carl	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	5	mg/L
5037497	Dissolved Organic Carl	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	8.6	mg/L
5042216	Dissolved Organic Carl	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	5.9	mg/L
5036669	Dissolved Organic Carl	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	4.3	mg/L
5027596	Dissolved Organic Carl	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		3.7	mg/L
5026708	Dissolved Organic Carl	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	6.7	mg/L
5020943	Dissolved Organic Carl	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	7.1	
5019075	Dissolved Organic Carl	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	8.8	
5016561	Dissolved Organic Carl	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	9.9	
5008183	Dissolved Organic Carl	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	10	
5009052	Dissolved Organic Carl	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	7	
5006981	Dissolved Organic Carl	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	8.6	mg/L
5004473	Dissolved Organic Carl	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	4.5	mg/L
5001380	Dissolved Organic Carl	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	6.1	mg/L
5000739	Dissolved Organic Carl	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	3.4	mg/L
4999648	Dissolved Organic Carl	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	3.9	mg/L
4997161	Dissolved Organic Carl	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	4.4	mg/L
4995338	Dissolved Organic Carl	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	4.7	mg/L
4994341	Dissolved Organic Carl	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	5.8	mg/L
4994815	Dissolved Organic Carl	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	9.4	mg/L
4990072	Dissolved Organic Carl	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	9.3	mg/L
4987408	Dissolved Organic Carl	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	4.3	mg/L
4986143	Dissolved Organic Carl	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	4.8	mg/L
4987246	Dissolved Organic Carl	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	5.3	mg/L
4984440	Dissolved Organic Carl	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	4.8	mg/L
4983010	Dissolved Organic Carl	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	3.1	mg/L
4981062	Dissolved Organic Carl	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	4.2	mg/L
4979699	Dissolved Organic Carl	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	4.3	mg/L
4976929	Dissolved Organic Carl	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	5.1	mg/L
4975208	Dissolved Organic Carl	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	4.5	mg/L
4973427	Dissolved Organic Carl	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	4.6	mg/L
4970793	Dissolved Organic Carl	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	3.2	mg/L
4968645	Dissolved Organic Carl	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	5.9	mg/L
4967825	Dissolved Organic Carl	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	4.1	mg/L
5067450	E. coli	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	24.3	MPN/10
5065259	E. coli	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	13.4	MPN/10
5064860	E. coli	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	81.3	MPN/10
5061838	E. coli	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	65	MPN/10
5059928	E. coli	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	231	MPN/10
5055419	E. coli	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	29.2	MPN/10
5054355	E. coli	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	11	MPN/10
5051993	E. coli	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	172.2	MPN/10
5050792	E. coli	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	2419.6	MPN/10
5048382	E. coli	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	866.4	MPN/10
5047259	E. coli	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	83.9	MPN/10
5044909	E. coli	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	145	MPN/10
5043781	E. coli	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	201.4	MPN/10
5043166	E. coli	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	104.6	MPN/10
5043030	E. coli	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	770.1	MPN/10
5037564	E. coli	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	307.6	MPN/10

5037045	E. coli	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	90.9	MPN/10
5041754	E. coli	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	2419.6	MPN/10
5036174	E. coli	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	85.7	MPN/10
5027723	E. coli	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		119.8	MPN/10
5026870	E. coli	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	461.1	MPN/10
5020515	E. coli	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	920.8	MPN/10
5018574	E. coli	CalTest	141-NWHFR-QE	NWHFR	Spec	9:00:00 AM	35	MPN/10
5016070	E. coli	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	14.5	MPN/10
5007938	E. coli	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	44.8	MPN/10
5008677	E. coli	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	2	MPN/10
5006706	E. coli	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	47.3	MPN/10
5004099	E. coli	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	488.4	MPN/10
5000777	E. coli	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	1203.3	MPN/10
5000390	E. coli	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	920.8	MPN/10
4999259	E. coli	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	1986.3	MPN/10
4996720	E. coli	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	2419.6	MPN/10
4994999	E. coli	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	461.1	MPN/10
4993894	E. coli	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	54.6	MPN/10
4994417	E. coli	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	280.9	MPN/10
4989721	E. coli	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	18.7	MPN/10
4987463	E. coli	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	86	MPN/10
4985920	E. coli	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	68.2	MPN/10
4986827	E. coli	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	1413.6	MPN/10
4984177	E. coli	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	579.4	MPN/10
4982553	E. coli	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	48.6	MPN/10
4980768	E. coli	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	1553.1	MPN/10
4979265	E. coli	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	1732.9	MPN/10
4976771	E. coli	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	178.5	MPN/10
4974781	E. coli	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	290.9	MPN/10
4972990	E. coli	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	122.3	MPN/10
4970421	E. coli	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	228.2	MPN/10
4968138	E. coli	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	122.3	MPN/10
4967426	E. coli	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	365.4	MPN/10
5067421	Hardness as CaCO3	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	290	mg/L
5065566	Hardness as CaCO3	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	210	mg/L
5065046	Hardness as CaCO3	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	200	mg/L
5062214	Hardness as CaCO3	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	68	mg/L
5060281	Hardness as CaCO3	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	250	mg/L
5055809	Hardness as CaCO3	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	460	mg/L
5054329	Hardness as CaCO3	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	300	mg/L
5052337	Hardness as CaCO3	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	240	mg/L
5051123	Hardness as CaCO3	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	190	mg/L
5048443	Hardness as CaCO3	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	220	mg/L
5047437	Hardness as CaCO3	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	450	mg/L
5045278	Hardness as CaCO3	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	290	mg/L
5044130	Hardness as CaCO3	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	180	mg/L
5043555	Hardness as CaCO3	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	250	mg/L
5043120	Hardness as CaCO3	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	220	mg/L
5037926	Hardness as CaCO3	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	190	mg/L
5037519	Hardness as CaCO3	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	390	mg/L
5042241	Hardness as CaCO3	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	220	mg/L
5036757	Hardness as CaCO3	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	680	mg/L
5027751	Hardness as CaCO3	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		320	mg/L
5026828	Hardness as CaCO3	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	190	mg/L
5021057	Hardness as CaCO3	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	150	mg/L
5019205	Hardness as CaCO3	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	250	mg/L
5016674	Hardness as CaCO3	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	230	mg/L
5008420	Hardness as CaCO3	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	200	mg/L
5009258	Hardness as CaCO3	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	140	mg/L
5007136	Hardness as CaCO3	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	150	mg/L
5004651	Hardness as CaCO3	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	170	mg/L
5000896	Hardness as CaCO3	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	420	mg/L
5000586	Hardness as CaCO3	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	240	mg/L
4999668	Hardness as CaCO3	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	390	mg/L
4997122	Hardness as CaCO3	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	320	mg/L
4995426	Hardness as CaCO3	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	380	mg/L
4994379	Hardness as CaCO3	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	340	mg/L
4994907	Hardness as CaCO3	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	460	mg/L
4990124	Hardness as CaCO3	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	380	mg/L
4988087	Hardness as CaCO3	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	190	mg/L
4986190	Hardness as CaCO3	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	790	mg/L
4987326	Hardness as CaCO3	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	280	mg/L
4984448	Hardness as CaCO3	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	830	mg/L

4982899	Hardness as CaCO3	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	460	mg/L
4981145	Hardness as CaCO3	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	370	mg/L
4979771	Hardness as CaCO3	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	430	mg/L
4977088	Hardness as CaCO3	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	580	mg/L
4975295	Hardness as CaCO3	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	580	mg/L
4973497	Hardness as CaCO3	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	790	mg/L
4970865	Hardness as CaCO3	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	540	mg/L
4968575	Hardness as CaCO3	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	380	mg/L
4967907	Hardness as CaCO3	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	710	mg/L
5065343	Lead	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	-0.06	ug/L
5064914	Lead	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	-0.06	ug/L
5061988	Lead	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	-0.06	ug/L
5060087	Lead	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	-0.06	ug/L
5055605	Lead	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	-0.06	ug/L
5054393	Lead	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	-0.06	ug/L
5052030	Lead	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	-0.06	ug/L
5050824	Lead	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	-0.06	ug/L
5041971	Lead	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	-0.06	ug/L
5036432	Lead	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	-0.06	ug/L
5036229	Lead	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	0.25	ug/L
5027231	Lead	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		0.41	ug/L
5026267	Lead	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	0.48	ug/L
5020717	Lead	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	1.2	ug/L
5018681	Lead	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	2	ug/L
5016144	Lead	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	0.52	ug/L
5007704	Lead	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	0.4	ug/L
5008712	Lead	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	0.7	ug/L
5004329	Lead	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	1.4	ug/L
5001131	Lead	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	0.35	ug/L
4987554	Lead	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	0.52	ug/L
4986905	Lead	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	0.95	ug/L
4968221	Lead	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	1.7	ug/L
4967456	Lead	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	0.29	ug/L
5027836	Lead (Dissolved)	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		-0.06	ug/L
5026486	Lead (Dissolved)	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	-0.06	ug/L
5020590	Lead (Dissolved)	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	-0.06	ug/L
5018884	Lead (Dissolved)	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	-0.06	ug/L
5016361	Lead (Dissolved)	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	-0.06	ug/L
5008005	Lead (Dissolved)	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	-0.06	ug/L
5008928	Lead (Dissolved)	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	0.07	ug/L
5004230	Lead (Dissolved)	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	-0.06	ug/L
5001200	Lead (Dissolved)	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	-0.06	ug/L
4987766	Lead (Dissolved)	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	0.04	ug/L
4987052	Lead (Dissolved)	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	0.08	ug/L
4968267	Lead (Dissolved)	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	-0.03	ug/L
4967623	Lead (Dissolved)	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	-0.03	ug/L
5067468	Molybdenum	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	2.1	ug/L
5065212	Molybdenum	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	2.1	ug/L
5064640	Molybdenum	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	2.2	ug/L
5061875	Molybdenum	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	2.1	ug/L
5060032	Molybdenum	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	2.5	ug/L
5055461	Molybdenum	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	4	ug/L
5054226	Molybdenum	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	3.7	ug/L
5052156	Molybdenum	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	4	ug/L
5050913	Molybdenum	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	1.9	ug/L
5048580	Molybdenum	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	1.8	ug/L
5047355	Molybdenum	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	3	ug/L
5044998	Molybdenum	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	2.3	ug/L
5043953	Molybdenum	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	1.5	ug/L
5043325	Molybdenum	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	1.9	ug/L
5042824	Molybdenum	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	1.4	ug/L
5037723	Molybdenum	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	1.6	ug/L
5037353	Molybdenum	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	6.1	ug/L
5041797	Molybdenum	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	2.7	ug/L
4987555	Molybdenum	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	2.7	ug/L
5065344	Nickel	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	1.8	ug/L
5064915	Nickel	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	2.1	ug/L
5061989	Nickel	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	1	ug/L
5060088	Nickel	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	2	ug/L
5055606	Nickel	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	2.6	ug/L
5054394	Nickel	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	2.4	ug/L
5052031	Nickel	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	2.4	ug/L
5050825	Nickel	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	2.6	ug/L

5041972	Nickel	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	2.9	ug/L
5036230	Nickel	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	4.1	ug/L
5036433	Nickel	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	2.8	ug/L
5027232	Nickel	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		3.1	ug/L
5026268	Nickel	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	3.9	ug/L
5020718	Nickel	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	7.1	ug/L
5018682	Nickel	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	16	ug/L
5016145	Nickel	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	4.4	ug/L
5007705	Nickel	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	3.4	ug/L
5008713	Nickel	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	4.8	ug/L
5004330	Nickel	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	9.5	ug/L
5001132	Nickel	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	5.2	ug/L
4987556	Nickel	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	4.6	ug/L
4986906	Nickel	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	5.9	ug/L
4968222	Nickel	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	14	ug/L
4967457	Nickel	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	4.5	ug/L
5027837	Nickel (Dissolved)	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		1.6	ug/L
5026487	Nickel (Dissolved)	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	2.4	ug/L
5020591	Nickel (Dissolved)	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	2.4	ug/L
5018885	Nickel (Dissolved)	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	2.6	ug/L
5016362	Nickel (Dissolved)	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	2.4	ug/L
5008006	Nickel (Dissolved)	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	2.8	ug/L
5008929	Nickel (Dissolved)	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	1.7	ug/L
5004231	Nickel (Dissolved)	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	2.5	ug/L
5001201	Nickel (Dissolved)	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	3.3	ug/L
4987767	Nickel (Dissolved)	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	2	ug/L
4987053	Nickel (Dissolved)	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	2.5	ug/L
4968268	Nickel (Dissolved)	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	4.2	ug/L
4967624	Nickel (Dissolved)	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	2.7	ug/L
5067775	Nitrate + Nitrite as N	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	0.63	mg/L
5065468	Nitrate + Nitrite as N	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	0.29	mg/L
5064807	Nitrate + Nitrite as N	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	0.2	mg/L
5062128	Nitrate + Nitrite as N	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	-0.07	mg/L
5059985	Nitrate + Nitrite as N	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	0.4	mg/L
5055710	Nitrate + Nitrite as N	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	0.11	mg/L
5054041	Nitrate + Nitrite as N	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	0.49	mg/L
5052246	Nitrate + Nitrite as N	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	1.3	mg/L
5051062	Nitrate + Nitrite as N	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	1.1	mg/L
5048526	Nitrate + Nitrite as N	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	1.1	mg/L
5047128	Nitrate + Nitrite as N	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	0.69	mg/L
5045199	Nitrate + Nitrite as N	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	1.1	mg/L
5044034	Nitrate + Nitrite as N	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	0.45	mg/L
5043466	Nitrate + Nitrite as N	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	0.28	mg/L
5043067	Nitrate + Nitrite as N	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	0.34	mg/L
5037840	Nitrate + Nitrite as N	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	1.1	mg/L
5037453	Nitrate + Nitrite as N	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	0.68	mg/L
5041879	Nitrate + Nitrite as N	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	1.3	mg/L
5036597	Nitrate + Nitrite as N	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	1.2	mg/L
5027547	Nitrate + Nitrite as N	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		1	mg/L
5026639	Nitrate + Nitrite as N	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	0.45	mg/L
5020902	Nitrate + Nitrite as N	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	0.35	mg/L
5019051	Nitrate + Nitrite as N	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	0.35	mg/L
5016527	Nitrate + Nitrite as N	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	0.3	mg/L
5008297	Nitrate + Nitrite as N	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	1	mg/L
5009139	Nitrate + Nitrite as N	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	0.26	mg/L
5007023	Nitrate + Nitrite as N	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	1.2	mg/L
5004429	Nitrate + Nitrite as N	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	1.3	mg/L
5000852	Nitrate + Nitrite as N	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	0.55	mg/L
5000658	Nitrate + Nitrite as N	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	0.41	mg/L
4999489	Nitrate + Nitrite as N	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	1.6	mg/L
4997060	Nitrate + Nitrite as N	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	1.2	mg/L
4995296	Nitrate + Nitrite as N	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	0.074	mg/L
4994092	Nitrate + Nitrite as N	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	0.038	mg/L
4994755	Nitrate + Nitrite as N	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	0.042	mg/L
4990021	Nitrate + Nitrite as N	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	0.039	mg/L
4987943	Nitrate + Nitrite as N	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	0.74	mg/L
4986105	Nitrate + Nitrite as N	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	0.43	mg/L
4987204	Nitrate + Nitrite as N	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	1.4	mg/L
4984214	Nitrate + Nitrite as N	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	0.32	mg/L
4982959	Nitrate + Nitrite as N	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	0.46	mg/L
4981044	Nitrate + Nitrite as N	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	0.62	mg/L
4979526	Nitrate + Nitrite as N	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	0.18	mg/L
4976983	Nitrate + Nitrite as N	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	0.069	mg/L

4975143	Nitrate + Nitrite as N	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	0.36	mg/L
4973359	Nitrate + Nitrite as N	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	0.46	mg/L
4970735	Nitrate + Nitrite as N	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	2.2	mg/L
4968601	Nitrate + Nitrite as N	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	2.2	mg/L
4967770	Nitrate + Nitrite as N	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	2.2	mg/L
5042720	Nitrogen, Total Kjeldal	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	1.6	mg/L
5036513	Nitrogen, Total Kjeldal	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	0.7	mg/L
5027466	Nitrogen, Total Kjeldal	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		0.92	mg/L
5026593	Nitrogen, Total Kjeldal	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	0.83	mg/L
5020834	Nitrogen, Total Kjeldal	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	2.9	mg/L
5018969	Nitrogen, Total Kjeldal	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	6	mg/L
5016447	Nitrogen, Total Kjeldal	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	3.1	mg/L
5008211	Nitrogen, Total Kjeldal	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	2.3	mg/L
5009074	Nitrogen, Total Kjeldal	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	2.2	mg/L
5007000	Nitrogen, Total Kjeldal	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	1.6	mg/L
5004494	Nitrogen, Total Kjeldal	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	1.9	mg/L
5001273	Nitrogen, Total Kjeldal	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	0.88	mg/L
5000616	Nitrogen, Total Kjeldal	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	0.92	mg/L
4999459	Nitrogen, Total Kjeldal	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	1.1	mg/L
4996905	Nitrogen, Total Kjeldal	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	1.4	mg/L
4995241	Nitrogen, Total Kjeldal	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	0.88	mg/L
4994243	Nitrogen, Total Kjeldal	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	1.4	mg/L
4994704	Nitrogen, Total Kjeldal	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	1.7	mg/L
4989978	Nitrogen, Total Kjeldal	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	1.7	mg/L
4987895	Nitrogen, Total Kjeldal	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	1.1	mg/L
4985883	Nitrogen, Total Kjeldal	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	1.1	mg/L
4987123	Nitrogen, Total Kjeldal	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	2	mg/L
4984117	Nitrogen, Total Kjeldal	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	0.7	mg/L
4982846	Nitrogen, Total Kjeldal	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	0.79	mg/L
4980995	Nitrogen, Total Kjeldal	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	1.1	mg/L
4979521	Nitrogen, Total Kjeldal	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	0.44	mg/L
4976887	Nitrogen, Total Kjeldal	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	1.4	mg/L
4975085	Nitrogen, Total Kjeldal	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	1.3	mg/L
4973209	Nitrogen, Total Kjeldal	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	1.7	mg/L
4970676	Nitrogen, Total Kjeldal	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	0.97	mg/L
4968370	Nitrogen, Total Kjeldal	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	1.9	mg/L
4967714	Nitrogen, Total Kjeldal	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	0.97	mg/L
5067674	OrthoPhosphate as P	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	0.066	mg/L
5065446	OrthoPhosphate as P	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	0.026	mg/L
5064786	OrthoPhosphate as P	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	0.023	mg/L
5062108	OrthoPhosphate as P	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	0.094	mg/L
5060144	OrthoPhosphate as P	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	0.17	mg/L
5055542	OrthoPhosphate as P	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	0.48	mg/L
5054106	OrthoPhosphate as P	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	0.21	mg/L
5052227	OrthoPhosphate as P	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	0.14	mg/L
5051031	OrthoPhosphate as P	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	0.2	mg/L
5048540	OrthoPhosphate as P	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	0.15	mg/L
5047501	OrthoPhosphate as P	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	0.043	mg/L
5045148	OrthoPhosphate as P	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	0.054	mg/L
5044016	OrthoPhosphate as P	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	0.05	mg/L
5043446	OrthoPhosphate as P	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	0.072	mg/L
5042741	OrthoPhosphate as P	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	0.14	mg/L
5037821	OrthoPhosphate as P	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	0.12	mg/L
5037430	OrthoPhosphate as P	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	0.1	mg/L
5042151	OrthoPhosphate as P	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	0.2	mg/L
5036559	OrthoPhosphate as P	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	0.25	mg/L
5027507	OrthoPhosphate as P	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		0.05	mg/L
5026628	OrthoPhosphate as P	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	0.071	mg/L
5020883	OrthoPhosphate as P	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	0.16	
5019011	OrthoPhosphate as P	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	0.32	
5016489	OrthoPhosphate as P	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	0.53	
5008256	OrthoPhosphate as P	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	0.39	
5009118	OrthoPhosphate as P	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	0.17	
5006687	OrthoPhosphate as P	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	0.21	mg/L
5004543	OrthoPhosphate as P	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	0.23	mg/L
5001293	OrthoPhosphate as P	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	0.11	mg/L
5000636	OrthoPhosphate as P	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	0.059	mg/L
4999512	OrthoPhosphate as P	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	0.066	mg/L
4997072	OrthoPhosphate as P	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	0.033	mg/L
4995260	OrthoPhosphate as P	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	0.025	mg/L
4994066	OrthoPhosphate as P	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	0.052	mg/L
4994738	OrthoPhosphate as P	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	1.6	mg/L
4989993	OrthoPhosphate as P	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	0.57	mg/L

4987919	OrthoPhosphate as P	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	0.29	mg/L
4985991	OrthoPhosphate as P	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	0.4	mg/L
4987166	OrthoPhosphate as P	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	0.14	mg/L
4984135	OrthoPhosphate as P	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	0.1	mg/L
4982942	OrthoPhosphate as P	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	0.038	mg/L
4981020	OrthoPhosphate as P	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	0.037	mg/L
4979592	OrthoPhosphate as P	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	0.054	mg/L
4976964	OrthoPhosphate as P	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	0.45	mg/L
4975105	OrthoPhosphate as P	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	0.47	mg/L
4973323	OrthoPhosphate as P	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	0.65	mg/L
4970714	OrthoPhosphate as P	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	0.095	mg/L
4968718	OrthoPhosphate as P	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	0.1	mg/L
4967732	OrthoPhosphate as P	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	0.097	mg/L
5042169	Phosphorus as P	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	0.4	mg/L
5036578	Phosphorus as P	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	0.3	mg/L
5027527	Phosphorus as P	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		0.11	mg/L
5026661	Phosphorus as P	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	0.16	mg/L
5020923	Phosphorus as P	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	0.47	mg/L
5019031	Phosphorus as P	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	0.81	mg/L
5016508	Phosphorus as P	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	0.79	mg/L
5008278	Phosphorus as P	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	0.6	mg/L
5009162	Phosphorus as P	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	0.37	mg/L
5007043	Phosphorus as P	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	0.38	mg/L
5004556	Phosphorus as P	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	0.39	mg/L
5001320	Phosphorus as P	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	0.16	mg/L
5000677	Phosphorus as P	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	0.11	mg/L
4999597	Phosphorus as P	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	0.11	mg/L
4997089	Phosphorus as P	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	0.068	mg/L
4995278	Phosphorus as P	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	0.044	mg/L
4994082	Phosphorus as P	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	0.1	mg/L
4994773	Phosphorus as P	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	1.6	mg/L
4990007	Phosphorus as P	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	0.65	mg/L
4987969	Phosphorus as P	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	0.33	mg/L
4985997	Phosphorus as P	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	0.43	mg/L
4987185	Phosphorus as P	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	0.21	mg/L
4984152	Phosphorus as P	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	0.11	mg/L
4982979	Phosphorus as P	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	0.084	mg/L
4981032	Phosphorus as P	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	0.058	mg/L
4979655	Phosphorus as P	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	0.092	mg/L
4977003	Phosphorus as P	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	0.54	mg/L
4975124	Phosphorus as P	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	0.55	mg/L
4973341	Phosphorus as P	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	0.77	mg/L
4970753	Phosphorus as P	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	0.16	mg/L
4968507	Phosphorus as P	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	0.26	mg/L
4967750	Phosphorus as P	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	0.14	mg/L
5067469	Selenium	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	0.34	ug/L
5065213	Selenium	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	-0.3	ug/L
5064641	Selenium	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	0.38	ug/L
5061876	Selenium	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	-0.3	ug/L
5060033	Selenium	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	0.6	ug/L
5055462	Selenium	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	0.87	ug/L
5054227	Selenium	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	0.5	ug/L
5052157	Selenium	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	1.4	ug/L
5050959	Selenium	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	0.77	ug/L
5048581	Selenium	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	0.77	ug/L
5047356	Selenium	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	0.65	ug/L
5044999	Selenium	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	0.49	ug/L
5043954	Selenium	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	0.42	ug/L
5043326	Selenium	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	0.49	ug/L
5042825	Selenium	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	0.57	ug/L
5037724	Selenium	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	0.45	ug/L
5037354	Selenium	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	0.91	ug/L
5041798	Selenium	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	0.73	ug/L
5036231	Selenium	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	1.1	ug/L
5027233	Selenium	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		0.37	ug/L
5026269	Selenium	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	0.43	ug/L
5020719	Selenium	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	0.4	ug/L
5018683	Selenium	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	1.1	ug/L
5016146	Selenium	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	0.36	ug/L
5007706	Selenium	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	0.43	ug/L
5008714	Selenium	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	0.53	ug/L
5004331	Selenium	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	0.53	ug/L
5001133	Selenium	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	0.41	ug/L

4987557	Selenium	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	0.65	ug/L
4986907	Selenium	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	0.75	ug/L
4968223	Selenium	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	0.77	ug/L
4967458	Selenium	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	1.4	ug/L
5036711	Total Dissolved Solids	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	1300	mg/L
5027658	Total Dissolved Solids	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		710	mg/L
5026777	Total Dissolved Solids	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	420	mg/L
5021013	Total Dissolved Solids	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	340	mg/L
5019156	Total Dissolved Solids	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	500	mg/L
5016629	Total Dissolved Solids	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	520	mg/L
5008356	Total Dissolved Solids	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	480	mg/L
5009209	Total Dissolved Solids	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	350	mg/L
5007080	Total Dissolved Solids	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	270	mg/L
5004568	Total Dissolved Solids	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	380	mg/L
5001410	Total Dissolved Solids	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	770	mg/L
5000494	Total Dissolved Solids	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	620	mg/L
4999548	Total Dissolved Solids	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	850	mg/L
4997094	Total Dissolved Solids	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	630	mg/L
4995378	Total Dissolved Solids	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	750	mg/L
4994366	Total Dissolved Solids	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	700	mg/L
4994864	Total Dissolved Solids	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	960	mg/L
4990093	Total Dissolved Solids	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	780	mg/L
4987433	Total Dissolved Solids	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	390	mg/L
4986173	Total Dissolved Solids	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	1600	mg/L
4987284	Total Dissolved Solids	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	420	mg/L
4984261	Total Dissolved Solids	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	1600	mg/L
4983059	Total Dissolved Solids	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	640	mg/L
4981115	Total Dissolved Solids	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	780	mg/L
4979730	Total Dissolved Solids	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	840	mg/L
4977024	Total Dissolved Solids	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	1100	mg/L
4975243	Total Dissolved Solids	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	1200	mg/L
4973453	Total Dissolved Solids	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	1500	mg/L
4970819	Total Dissolved Solids	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	1000	mg/L
4968675	Total Dissolved Solids	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	800	mg/L
4967858	Total Dissolved Solids	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	1600	mg/L
5067566	Total Organic Carbon	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	4.2	mg/L
5065519	Total Organic Carbon	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	3.8	mg/L
5064985	Total Organic Carbon	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	4.9	mg/L
5062191	Total Organic Carbon	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	6.4	mg/L
5060330	Total Organic Carbon	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	4.9	mg/L
5055767	Total Organic Carbon	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	9	mg/L
5054133	Total Organic Carbon	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	10	mg/L
5052290	Total Organic Carbon	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	5	mg/L
5051100	Total Organic Carbon	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	6.2	mg/L
5048423	Total Organic Carbon	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	7.5	mg/L
5047172	Total Organic Carbon	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	3.8	mg/L
5045177	Total Organic Carbon	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	4	mg/L
5044094	Total Organic Carbon	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	6.3	mg/L
5043533	Total Organic Carbon	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	4.9	mg/L
5043078	Total Organic Carbon	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	5.5	mg/L
5037908	Total Organic Carbon	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	4.6	mg/L
5037483	Total Organic Carbon	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	9.5	mg/L
5041921	Total Organic Carbon	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	5.6	mg/L
5036651	Total Organic Carbon	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	4.7	mg/L
5027611	Total Organic Carbon	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		3.8	mg/L
5026723	Total Organic Carbon	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	7.5	mg/L
5020965	Total Organic Carbon	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	7.7	mg/L
5019097	Total Organic Carbon	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	10	mg/L
5016584	Total Organic Carbon	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	10	mg/L
5008151	Total Organic Carbon	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	9.6	mg/L
5009020	Total Organic Carbon	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	7.1	mg/L
5006598	Total Organic Carbon	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	9.4	mg/L
5004406	Total Organic Carbon	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	4.1	mg/L
5001356	Total Organic Carbon	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	5.8	mg/L
5000720	Total Organic Carbon	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	3.5	mg/L
4999640	Total Organic Carbon	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	3.7	mg/L
4996947	Total Organic Carbon	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	4.4	mg/L
4995317	Total Organic Carbon	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	5.1	mg/L
4994319	Total Organic Carbon	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	6.2	mg/L
4994796	Total Organic Carbon	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	11	mg/L
4990057	Total Organic Carbon	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	9.6	mg/L
4988022	Total Organic Carbon	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	4.3	mg/L
4986131	Total Organic Carbon	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	4.6	mg/L

4987251	Total Organic Carbon	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	5.4	mg/L
4984422	Total Organic Carbon	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	4.8	mg/L
4982876	Total Organic Carbon	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	3.2	mg/L
4981077	Total Organic Carbon	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	4.2	mg/L
4979680	Total Organic Carbon	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	4.5	mg/L
4976900	Total Organic Carbon	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	5.3	mg/L
4975186	Total Organic Carbon	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	5.9	mg/L
4973381	Total Organic Carbon	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	4.8	mg/L
4970906	Total Organic Carbon	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	2.9	mg/L
4968533	Total Organic Carbon	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	6	mg/L
4967839	Total Organic Carbon	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	3.9	mg/L
5067394	Total Suspended Solid	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	5	mg/L
5065180	Total Suspended Solid	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	7	mg/L
5064602	Total Suspended Solid	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	18	mg/L
5061814	Total Suspended Solid	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	4	mg/L
5059958	Total Suspended Solid	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	23	mg/L
5055396	Total Suspended Solid	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	8	mg/L
5054351	Total Suspended Solid	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	5	mg/L
5051968	Total Suspended Solid	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	20	mg/L
5050771	Total Suspended Solid	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	62	mg/L
5048357	Total Suspended Solid	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	30	mg/L
5047235	Total Suspended Solid	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	95	mg/L
5044887	Total Suspended Solid	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	26	mg/L
5043760	Total Suspended Solid	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	50	mg/L
5043140	Total Suspended Solid	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	23	mg/L
5042689	Total Suspended Solid	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	125	mg/L
5037540	Total Suspended Solid	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	37	mg/L
5037026	Total Suspended Solid	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	25	mg/L
5041732	Total Suspended Solid	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	58	mg/L
5036148	Total Suspended Solid	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	11	mg/L
5027694	Total Suspended Solid	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		11	mg/L
5026206	Total Suspended Solid	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	18	mg/L
5020494	Total Suspended Solid	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	89	mg/L
5018547	Total Suspended Solid	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	41	mg/L
5016037	Total Suspended Solid	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	17	mg/L
5007906	Total Suspended Solid	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	12	mg/L
5008653	Total Suspended Solid	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	29	mg/L
5006566	Total Suspended Solid	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	17	mg/L
5004076	Total Suspended Solid	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	22	mg/L
5000760	Total Suspended Solid	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	12	mg/L
5000327	Total Suspended Solid	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	25	mg/L
4999239	Total Suspended Solid	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	18	mg/L
4996700	Total Suspended Solid	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	23	mg/L
4994980	Total Suspended Solid	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	15	mg/L
4994262	Total Suspended Solid	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	6	mg/L
4994397	Total Suspended Solid	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	9	mg/L
4989706	Total Suspended Solid	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	8	mg/L
4987436	Total Suspended Solid	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	-2	mg/L
4985905	Total Suspended Solid	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	4	mg/L
4986803	Total Suspended Solid	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	17	mg/L
4984162	Total Suspended Solid	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	5	mg/L
4982535	Total Suspended Solid	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	18	mg/L
4980713	Total Suspended Solid	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	15	mg/L
4979296	Total Suspended Solid	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	28	mg/L
4976567	Total Suspended Solid	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	11	mg/L
4974760	Total Suspended Solid	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	32	mg/L
4972965	Total Suspended Solid	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	31	mg/L
4970400	Total Suspended Solid	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	40	mg/L
4968114	Total Suspended Solid	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	45	mg/L
4967405	Total Suspended Solid	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	30	mg/L
5067542	Turbidity	CalTest	161-NWHFR-QE	NWHFR	10-Sep-19	8:50:00 AM	1.6	NTU
5065544	Turbidity	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	4.4	NTU
5064829	Turbidity	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	6.8	NTU
5062146	Turbidity	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	2.8	NTU
5060307	Turbidity	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	20	NTU
5055730	Turbidity	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	4.2	NTU
5054148	Turbidity	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	3.2	NTU
5052268	Turbidity	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	36	NTU
5051079	Turbidity	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	130	NTU
5048348	Turbidity	CalTest	R24-NWHFR-QE	NWHFR	30-Nov-18	9:30:00 AM	50	NTU
5047416	Turbidity	CalTest	154-NWHFR-QE	NWHFR	9-Oct-18	9:00:00 AM	50	NTU
5045220	Turbidity	CalTest	153-NWHFR-QE	NWHFR	11-Sep-18	9:00:00 AM	14	NTU
5044053	Turbidity	CalTest	152-NWHFR-QE	NWHFR	14-Aug-18	9:00:00 AM	26	NTU

5043487	Turbidity	CalTest	151-NWHFR-QE	NWHFR	10-Jul-18	9:00:00 AM	12	NTU
5042775	Turbidity	CalTest	150-NWHFR-QE	NWHFR	12-Jun-18	9:00:00 AM	55	NTU
5037867	Turbidity	CalTest	149-NWHFR-QE	NWHFR	8-May-18	9:05:00 AM	33	NTU
5037466	Turbidity	CalTest	148-NWHFR-QE	NWHFR	10-Apr-18	10:00:00 AM	19	NTU
5042192	Turbidity	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	80	NTU
5036626	Turbidity	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	9.4	NTU
5027567	Turbidity	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		14	NTU
5026684	Turbidity	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	16	NTU
5020991	Turbidity	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	39	NTU
5019118	Turbidity	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	36	NTU
5016605	Turbidity	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	13	NTU
5008333	Turbidity	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	8.5	NTU
5009177	Turbidity	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	2.5	NTU
5007060	Turbidity	CalTest	137-NWHFR-QE	NWHFR	14-Feb-17	9:45:00 AM	80	NTU
5004503	Turbidity	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	50	NTU
5001338	Turbidity	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	10	NTU
5000695	Turbidity	CalTest	136-NWHFR-QE	NWHFR	11-Oct-16	9:05:00 AM	10	NTU
4999619	Turbidity	CalTest	135-NWHFR-QE	NWHFR	13-Sep-16	9:15:00 AM	11	NTU
4997180	Turbidity	CalTest	134-NWHFR-QE	NWHFR	9-Aug-16	9:10:00 AM	8.9	NTU
4995358	Turbidity	CalTest	133-NWHFR-QE	NWHFR	12-Jul-16	9:00:00 AM	8	NTU
4994300	Turbidity	CalTest	132-NWHFR-QE	NWHFR	14-Jun-16	9:00:00 AM	4.4	NTU
4994845	Turbidity	CalTest	131-NWHFR-QE	NWHFR	10-May-16	9:15:00 AM	7	NTU
4990037	Turbidity	CalTest	130-NWHFR-QE	NWHFR	12-Apr-16	10:10:00 AM	3	NTU
4987997	Turbidity	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	16	NTU
4986154	Turbidity	CalTest	129-NWHFR-QE	NWHFR	9-Feb-16	9:00:00 AM	2.3	NTU
4987223	Turbidity	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	22	NTU
4984405	Turbidity	CalTest	128-NWHFR-QE	NWHFR	20-Oct-15	9:00:00 AM	3.5	NTU
4983028	Turbidity	CalTest	127-NWHFR-QE	NWHFR	15-Sep-15	9:20:00 AM	23	NTU
4981088	Turbidity	CalTest	126-NWHFR-QE	NWHFR	11-Aug-15	9:00:00 AM	7.4	NTU
4979632	Turbidity	CalTest	125-NWHFR-QE	NWHFR	14-Jul-15	9:00:00 AM	12	NTU
4977043	Turbidity	CalTest	124-NWHFR-QE	NWHFR	9-Jun-15	8:30:00 AM	12	NTU
4975164	Turbidity	CalTest	123-NWHFR-QE	NWHFR	12-May-15	9:00:00 AM	17	NTU
4973405	Turbidity	CalTest	122-NWHFR-QE	NWHFR	14-Apr-15	9:06:00 AM	15	NTU
4970771	Turbidity	CalTest	121-NWHFR-QE	NWHFR	10-Mar-15	9:15:00 AM	18	NTU
4968623	Turbidity	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	45	NTU
4967793	Turbidity	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	16	NTU
5065345	Zinc	CalTest	160-NWHFR-QE	NWHFR	13-Aug-19	9:00:00 AM	-0.7	ug/L
5064916	Zinc	CalTest	159-NWHFR-QE	NWHFR	9-Jul-19	9:00:00 AM	0.8	ug/L
5061990	Zinc	CalTest	158-NWHFR-QE	NWHFR	11-Jun-19	9:00:00 AM	27	ug/L
5060089	Zinc	CalTest	157-NWHFR-QE	NWHFR	14-May-19	8:45:00 AM	7.9	ug/L
5055607	Zinc	CalTest	156-NWHFR-QE	NWHFR	9-Apr-19	9:00:00 AM	13	ug/L
5054395	Zinc	CalTest	155-NWHFR-QE	NWHFR	12-Mar-19	9:30:00 AM	11	ug/L
5052032	Zinc	CalTest	R26-NWHFR-QE	NWHFR	14-Feb-19	10:00:00 AM	29	ug/L
5050826	Zinc	CalTest	R25-NWHFR-QE	NWHFR	17-Jan-19	9:45:00 AM	5.4	ug/L
5041973	Zinc	CalTest	R23-NWHFR-QE	NWHFR	2-Mar-18	9:40:00 AM	3.5	ug/L
5036232	Zinc	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	4.2	ug/L
5036434	Zinc	CalTest	146-NWHFR-QE	NWHFR	13-Feb-18	9:30:00 AM	-0.7	ug/L
5027234	Zinc	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		3.4	ug/L
5026270	Zinc	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	2.7	ug/L
5020720	Zinc	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	32	ug/L
5018684	Zinc	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	14	ug/L
5016147	Zinc	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	33	ug/L
5007707	Zinc	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	30	ug/L
5008715	Zinc	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	7.2	ug/L
5004332	Zinc	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	14	ug/L
5001134	Zinc	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	2.6	ug/L
4987558	Zinc	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	4.4	ug/L
4986908	Zinc	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	10	ug/L
4968224	Zinc	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	12	ug/L
4967459	Zinc	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	1.8	ug/L
5027838	Zinc (Dissolved)	CalTest	145-NWHFR-QE	NWHFR	10-Oct-17		-0.7	ug/L
5026488	Zinc (Dissolved)	CalTest	144-NWHFR-QE	NWHFR	12-Sep-17	10:10:00 AM	-0.7	ug/L
5020592	Zinc (Dissolved)	CalTest	142-NWHFR-QE	NWHFR	11-Jul-17	9:00:00 AM	11	ug/L
5018886	Zinc (Dissolved)	CalTest	141-NWHFR-QE	NWHFR	13-Jun-17	9:00:00 AM	1.4	ug/L
5016363	Zinc (Dissolved)	CalTest	140-NWHFR-QE	NWHFR	9-May-17	9:20:00 AM	2.2	ug/L
5008007	Zinc (Dissolved)	CalTest	139-NWHFR-QE	NWHFR	11-Apr-17	10:15:00 AM	14	ug/L
5008930	Zinc (Dissolved)	CalTest	138-NWHFR-QE	NWHFR	14-Mar-17	9:00:00 AM	2.1	ug/L
5004232	Zinc (Dissolved)	CalTest	R21-NWHFR-QE	NWHFR	10-Jan-17	10:15:00 AM	2.6	ug/L
5001202	Zinc (Dissolved)	CalTest	R20-NWHFR-QE	NWHFR	1-Nov-16	10:10:00 AM	1	ug/L
4987768	Zinc (Dissolved)	CalTest	R19-NWHFR-QE	NWHFR	8-Mar-16	10:00:00 AM	0.7	ug/L
4987054	Zinc (Dissolved)	CalTest	R18-NWHFR-QE	NWHFR	7-Jan-16	10:10:00 AM	3.1	ug/L
4968269	Zinc (Dissolved)	CalTest	R17-NWHFR-QE	NWHFR	10-Feb-15	10:20:00 AM	1.4	ug/L
4967625	Zinc (Dissolved)	CalTest	120-NWHFR-QE	NWHFR	13-Jan-15	9:15:00 AM	-0.7	ug/L

UNIVERSITY OF CALIFORNIA
MERCED

NEWMAN CONSTRUCTED TREATMENT WETLAND POLLUTANT REMOVAL MODELING REPORT

(Memorandum 4)
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DRAFT

Prepared by
Naivy Dennise Rodal Morales, Ph.D. Student, Environmental Systems Graduate Group
Dr. Marc Beutel, Associate Professor, Civil and Environmental Engineering, Environmental Systems Graduate Group

1. SUMMARY

This report (Memorandum 4) covers modeling pollutant removal for the 30-acres constructed treatment wetland in the southwest corner of the study site in Newman City. Constructed wetlands are effective treatment systems that utilize biological processes, vegetation, and soil properties to treat waterborne pollutants. The City of Newman aims to reduce incoming pollutants (nitrate and total phosphorus (TP)), so that the treated water can be reused in agricultural fields. At the same time, the City looks for low salinity increment after the treatment, as the watershed of the area already has high salinity concentration that affects agriculture of the region.

Pollutant removal was developed using the P-k-C* model by *Kadlec and Wallace* (*2009*) that requires hydrologic and water quality information of the area, presented in detail in Memorandum 2 and 3, to determine the outlet concentration of the pollutants in the proposed wetland. Thus, this report presents three monthly yearly-averaged scenarios, normal, dry, and wet year, showing percentage reduction, percentage mass removal, and areal mass removal for nitrogen and phosphorus. The report also includes a comparison between a 30-acres and a 10-acres normal year wetland to access the important effect of wetland area on pollutant removal. Likewise, it presents a normal year 30-acres salinity model to show salinity behavior in the wetland.

The results indicate that the percentage removal for nitrate is 73% (outlet concentration C_o = 0.49 mg/L) and for TP is 62% (C_o = 0.11 mg/L) in a normal year 30-acres with a 9 days residence time. When comparing wet and dry years, both nitrate and TP have higher percentage reduction during the dry year with 79% and 68%, respectively, due to a hydraulic residence time increment (14 days). Although, wet year removal is still high with 65% for nitrate and 59% for TP. However, nitrate has higher areal mass removal during the wet year of 45 g/m^{2}yr as the loading rate in the inflow (LRI) to the wetland increased (71 g/m^{2}yr), compared to the dry year value of 39 g/m^{2}yr and 43 g/m^{2}yr LRI. These values confirm the relation between high LRI and high areal mass removal for nitrate, even though a high LRI also tends to correspond with a higher C_o. Finally, nitrate has a 45%reduction and a TP 19% reduction in the 10-acres wetland, which is much lower than the 30-acres wetland. These last comparison shows better removal with larger areas as it is favored by high residence times.

Likewise, the models showed different seasonality for the compounds. Nitrate is highly dependent on temperature as it is microbially mediated. Thus, denitrification reactions, where bacteria convert nitrate to harmless nitrogen gas, are favored under warmer conditions. Thus, removal is better during summertime. On the contrary, TP follows the plant seasonal cycle of uptake and burial, having two peaks of removal.

The first one during spring-summer and the second peak during autumn time. The lowest removal is in summer when plants die, and they are biodegraded and release much of their stored phosphorus back to the wetland water column.

The last pollutant, salinity, shows a small increment of 14% during the 30-acres normal year scenario. The results presented for TP and nitrate and the small salinity increment demonstrate that the constructed wetland is a good solution for City purposes.

2. INTRODUCTION

Newman City is located in Stanislaus county in Central Valley, California where agriculture is the dominant industry and occupation. The soils are formed by sandy clays promotes high infiltration rates, according with the measurements made by RICK Engineering (*190156001 Geo. Report, Infiltration Tests, 2019*). The City has Mediterranean weather and an annual minimum and maximum temperature of 9°C and 27°C (48°F and 80°F) respectively, and an average annual precipitation of 29.4 cm (11.59 inch) *(US Climate data).* Finally, Newman City is part of the Delta-Mendota Canal Hydrologic Unit in San Joaquin Hydrologic Basin, which is considered as high priority category for water management (*California Regional Water Quality Control Board, 2018*). Therefore, the City of Newman is planning to build a constructed wetland, which is a sustainable technique to treat agricultural runoff and agricultural delivery through-flow and potentially reuse it for irrigation and groundwater recharge purposes.

Agricultural runoff tends to be a source of nitrogen and phosphorus pollution to lakes and rivers causing eutrophication, in which algae blooms proliferate and then die, causing deoxygenation of waters and death of aquatic biota as the algae is biodegraded. Nitrate pollution from agricultural actives can also contaminate groundwater used for potable uses, which can cause blue baby syndrome at elevated concentrations *(Center for Watershed Sciences, 2012).* However, due to their high biogeochemical activity, constructed wetland systems can be an effective and economical eco-technology to treat agricultural runoff by transforming pollutants, such as nitrate and phosphate, into less harmful substances. Likewise, wetlands provide important areas for wildlife habitat and human recreation (*Kadlec and Wallace, 2009*). The designated area for the prospected treatment wetland is 30-acres of land localized in the southwest corner of the study site, adjacent to Canal School Rd and Baraza Rd *(Fig. 1).* The modeled wetland will be a free water surface type (FWS) which has the main characteristic of open water and floating and emergent vegetation. FWS wetlands are suitable in all climates and allow for high

removal rates for nitrogen and phosphorus, making them a perfect treatment, habitat, and recreation alternative for the City purposes (*Kadlec and Wallace, 2009*).

The main objective of the study is to model and predict the amount of nitrate and TP that can be removed in the 30-acres of area using the P-k-C* model developed by *Kadlec and Wallace (2009*).The model, which couples hydrologic processes with pollutant removal dynamics, was assessed for monthly pollutant removal under three different hydraulic scenarios: normal year, dry year, and wet year. In addition, to assess the impact of wetland area on pollutant removal, we compared a normal year model using 10-acres of area against the normal year 30-acres model. In general, the larger the wetland the more time the water is in the wetland. Holding time results in enhanced pollutant removal. Thus, removal is better in low-flow dry years and in larger wetlands. In addition, FWS treatment wetlands are generally better at removing nitrogen which can be removed via relatively fast microbial process, compared to phosphorus which is mainly removed via the slower process of plant uptake and burial of plant litter. Note that recommendations related to design of the wetland, including consideration of inlets and outlets, layout, flow paths and the vegetation type, will be present in a later memorandum.

Modeling was based on hydrologic and water quality monitoring and assessment by the project team as detailed in previously submitted Memorandum 2 (*Water Budget*) and Memorandum 3 (*Water Quality*). The hydraulic results presented estimated flow for Miller Ditch (MD) of 4,117 m^3/day, with apparently higher flow at the beginning and at the end of the irrigation season; and a total inflow to the prospected wetland of 8,192 m^3/day, which represents flow from MD and possible runoff from the agriculture south land, with an average hydraulic residence time of 9 days (*Table 1*). Moreover, monthly water samples were taken to measure nutrients, including ammonia (NH_4^+), nitrate (NO_3^-), total phosphorus (TP) and dissolved phosphate (PO_4^{3-}); for sediment in the water via total suspended solids (TSS); and for salinity in the water via electrical conductivity (EC). Salinity is another important goal to be modeled as groundwater of the watershed has a high salinity concentration that affects agriculture of Newman City. On average, the measured concentrations coming into the treatment wetland from MD showed 0.27 mg-P/L for TP, 0.14 mg-P/L for PO_4^{3-}, 0.16 mg-N/L for NH_4^+, 1.91 mg-N/L for nitrate, 662 uS/cm for EC, and 81 mg/L for TSS (*Table 2*), which corresponds to normal agricultural water values.

3. METHODS

3.1 Model Equations

When modeling pollutant removal, there are two possible ways to develop the model. The first approach uses a target outflow pollutant concentration to calculate the required wetland area, while the second approach uses a target area and models for the wetland´s outlet concentration. For both approaches, key model inputs are inflow concentration, water budget metrics (e.g., inflow, precipitation, evapotranspiration), flow and mixing characteristics of the wetland, and the removal rate of a given pollutant. For this study, we have assumed 30-acres of land to use for the wetland. Thus, the pollutant mass balance was developed using the second approach, a target area and calculating the estimated C_o.

The model used was the P-k-C* for nitrate and TP presented by *Kadlec and Wallace* (*2009*). We start with a mass balance of a given pollutant as presented in *Eq. 1* which assumes a fully mixed compartment of water.

$$Q_1 C_1 = (Q_{in} C_{in}) - (I \cdot A_1 C_1) - (\alpha ET \cdot A_1 C_1) - \left(k \cdot A_1 \cdot (C_1 - C^*)\right) \qquad \textit{(Eq. 1)}$$

The first term on the left describes the mass leaving the wetland (Q_1 term), while the terms on the right demonstrate the mass entering the wetland (Q_{in} term), as well as the mass leaving the wetland due to infiltration (*I* term), transpiration flux (*α* term) and transformations (*k* term) inside the wetland. Transpiration is the loss of water vapor by plants that move from the water column through the sediment to the roots, then out the leaves and flowers. As the water moves through the sediment and root zone, nutrients and mobile elements in water susceptible to filtration and bioreactions are transformed and lost from the wetland (*Kadlec and Wallace, 2009*). On the other hand, the transformation term represents the concentration removal, dependent on the first areal loss rate k, which shows better removal rate with higher concentration. For nitrate the k term would account for the rate of biological transformation to nitrogen gas. For TP the k term would account for the rate of plant uptake and burial. Another factor included with this term is the background concentration (C*), which accounts for possible internal sources the pollutant in the wetland, such as resuspended sediment, floating particles and release from plant decay. Thus, for some pollutants the model does not allow for full removal (*Kadlec and Wallace, 2009)*.

Next, we solve *Eq. 1* for the outflow concentration C_1 as shown in *Eq. 2*:

$$C_1 = \frac{Q_i C_{in} + (k \cdot A_1 \cdot C^*)}{Q_1 + \left((\alpha ET) A_1\right) + (I \cdot A_1) + (k \cdot A_1)} \qquad \textit{(Eq. 2)}$$

where C_1 is outflow pollutant concentration (g/m^3), Q_{in} is the inflow to the wetland (m^3/d), C_{in} the inflow concentration to the wetland (g/m^3), k the areal-based first order removal rates (m/d), C* the background concentration (g/m^3), α the transpiration fraction, ET evapotranspiration (m/d), I the infiltration rate (m/d), and A_1 the area of the tank (m^2).

We break the wetland into hypothetical "tanks" to better model the flow of water through an actual wetland. Shallow wetlands do not act as a fully mixed tank, instead, they are better modelled as separate "tanks in series" (*Fig. 2*). Treatment wetlands have been shown to typically act like 3-4 tanks in series. For our model we split the wetland into 4 hypothetic tanks, each with an area of 30 acres divided by 4 (7.5 acres, 30,352 m^2). In this scheme, C_1 is both the outlet concentration from tank 1 and the inflow concentration (C_{in}) to tank 2. *Eq. 2* is then solved sequentially for each tank, with C_4, the outflow concentration from the last tank, being equal to the concentration in the outflow concentration from the wetland.

3.2 Hydrology

The hydrologic information was collected for the different scenarios: normal, dry, and wet monthly years, as summarized in *Tables 1 and 3,* which present precipitation, evapotranspiration, and inflow values to the wetland. For a dry year, the 20th percentile of the median precipitation from NOAA was used, while for the wet year the 80th percentile. In the three scenarios, the evapotranspiration values were the same as we considered there is no variation throughout the years. Infiltration was assumed to be zero for modeling purposes after the suggestion of an impermeable layer on top of soil to control the high infiltration rates. Hydrologic information is presented in more detail in Memorandum 2, a draft of which was submitted in July 2020.

3.3 Inflow Water Quality

As noted earlier, inlet concentration was needed for the model. Sampling at MD gave the background information of the estimated incoming concentration of nitrate and TP to the proposed wetland during the dry season (C_{MD}). These values averaged 1.91 mg-N/L for nitrate and 0.27 mg-P/L for TP (*Table 2*). However, as there were few sampling events that captured wet-season storm-flow events, we did not have sufficient data to model wet-season water quality. So, we used typical concentration found in agricultural runoff (C_{AR}) of 2.2 mg-N/L for nitrate and 0.34 mg-P/L for TP based on *Kadlec and Wallace (2009)*. We then estimated, on a monthly basis, a flow-weighted average concentration from both MD and from wet-season agricultural runoff using Eq. 3, where Q_{MD} is estimated flow in MD and Q_{AR} is wet-

season agricultural runoff flow. The results are presented in *Table 4* and were used for the three scenarios to model the monthly removal. Water quality information is presented in more detail in Memorandum 3, a draft of which was submitted in June 2020.

$$Ci = \frac{(Q_{MD} * C_{MD}) + (Q_{AR} * C_{AR})}{Q_{MD} + Q_{AR}} \qquad \textit{(Eq. 3)}$$

3.4 Removal Rates

The last two parameters for the model are the background concentration (C*) and the areal first-order rate constants (k), which for nitrate is highly dependent on temperature, and TP which is more dependent on the seasonal growth cycle of plants. To determine C*, we used recommended values from *Kadlec and Wallace* (*2009*). Because phosphorus has two sinks, one short-term by co-precipitation with iron minerals, and the second one long-term by plant uptake and burial, it has two C* values depending on the time of the year. During summer we use the value of 0.01 g/m^3. During winter, when the plants uptake and burial activity is less effective and some minerals can be re-dissolved in the water, we use the higher value of 0.04 g/m^3. For nitrate, the sink is due to microbial activity via denitrification. In this case, C* is zero during summer but 0.01 g/m^3 during wintertime when temperatures are lower and microbial removal effectiveness is lower.

Monthly values of k, the areal first order removal coefficient, were determined differently for nitrate and TP. For nitrate we assumed a k_{20} value, the rate at 20 ˚C, for nitrate of 40 m/yr based on values reported for similar lightly loaded treatment systems, including a similar treatment wetland in Washington state studied by Dr. Beutel (*Beutel et al., 2009*). This value was equivalent to the 80 percentile value suggested by *Kadlec and Wallace (2009).* To model monthly k values for nitrate, we note that nitrate follows the Arrhenius equation (*Eq. 4)* because microbial activity is strongly sensitive to temperature. Therefore, the mean monthly air temperature at Newman City (*US Climate data*) was used to adjust the k value using a typical θ value of 1.11 (*Table 5):*

$$k = k_{20}\theta^{T-20°C} \qquad \textit{(Eq. 4)}$$

For TP, k values were estimated according to values reported for similar lightly loaded treatment systems, including a similar treatment wetland in Washington state studied by Dr. Beutel *(Beutel et al., 2014)*. Thus, we used a mean k value of 25 m/yr, which represents the 80th percentile k value suggested by *Kadlec and Wallace*

(2009). We then used professional judgement and results from studies of similar treatment wetlands to develop a monthly k values based on patterns of plant seasonality. Hence, due to the type of weather the City has, Mediterranean with medium cold winters, and the relatively low concentration of TP in wetland inflow, the values selected for the different months varied seasonally. Winter values fluctuate between 10 m/yr, when plant growth is low, to 27 m/yr, in late fall/early winter when roots take up P to overwinter. Summer values typically range from 20-26 my/yr, when the uptake is not as high as the decay and recycling rates of the death plants. However, there are two peaks in k values, one during spring of 45 m/yr that corresponds to high plant growth rates, and the second one during fall of 35 m/yr when plants tend to store nutrients in the roots over the winter *(Table 5*).

Finally, salinity for a normal year for a 30-acre wetland was calculated by the ratio between the inflow and outflow of each tank multiplied by the previous tank´s concentration: $S_1 = S_i*(Q_{in}/Q_o)$ in µS/cm. Salinity concentration removal is based on the amount of water each tank contained (volume) after evapotranspiration (ET) and the precipitation (PP) mechanisms. During spring-summer time higher temperatures induces higher ET rates that reduces the volume of water and concentrate amount of salts in water. Likewise, due to Mediterranean weather, during fall and winter, precipitation allows some dilution of the salts as the volume of water increases in the wetland.

4. RESULTS

For the P-K-C* model, the total area of 121,406 m^2 (30-acres) was divided into four equal tanks of 30,352 m^2 for the normal, wet, and dry year scenarios. The normal year model with 10-acres was also divided into four equal tanks of 10,117 m^2 for the calculation's purposes. The results include the following metrics: percent reduction, percent mass removal, areal mass removal, loading rate in the inflow (LRI) and outflow concentration (C_o). We also assessed the 90th percentile C_o, which accounts for unpredictable intra-system variability of pollutant removal. The value of C_o is predicted to be below this value 90% of the time. On rare occasions due to unforeseen and uncontrollable events and processes, C_o will exceed this value.

Nitrate

Nitrate is a nutrient used for plant growth which in excess can migrate in agricultural runoff into the surface and groundwater causing eutrophication and the contamination of groundwater supply for potable use *(Kadlec and Wallace, 2009)*. The toxicity of the groundwater affects infants generating the blue baby health condition called "methylglobanemia", a blue skin coloration due to the lack of oxygen

in the blood (*USEPA 2002, Center for Watershed Sciences, 2012).* In wetlands, nitrate is transformed into dinitrogen gas (N_2) via denitrification reaction, which is a microbial reduction favored under anaerobic low dissolved oxygen (DO) conditions. Denitrification is highly sensitive to temperature (*Kadlec and Wallace, 2009*). Loading rates also affect removal rates. When wetlands have high areal nitrate loading, the areal removal rate tends to increase, while percent concentration removal decreases (*Beutel et, al. 2009).* Lastly, a potenital source of nitrate in wetlands is nitrification, the biological conversion of ammonia to nitrite (*Kadlec and Wallace, 2009*). For the scenarios modeled, the production of nitrate due to ammonia transformation was not considered due to the low ammonia in inflow from MD to the wetland, which is mostly going to be used for plants to grow *(Table 2).*

The models show that nitrate has a percentage of mass removal higher than typical book values of around 60%. Nitrate enters to the wetland with an initial average concentration of 1.97 mg-N/L and has an outlet concentration of 0.5 mg-N/L (0.96 mg-N/L after applying the 90th percentile assessment) during the normal year model. This is a reduction of the 73% which is equivalent to a 75% mass removal and a 36 g-N/m^{2}yr areal mass removal. The model also shows a residence time of 9 days and a mean LRI of 48 g-N/m^{2}yr (*Table 6)*. However, removal efficiency decreases during winter months with 57% on average and has a peak removal from June to August of 95% (*Fig 5*). The lowest outlet concentrations are found during the summer months and are due to nitrate reduction acceleration under warmer conditions *(Fig. 3).* This microbial seasonality is due to the relation between temperature and rate constant, which peaks in July and matches the peak temperature of 28°C, showing higher microbial mediation of the wetland during summer months (*Fig.4*).

Looking at the differences between nitrate removal in dry and wet year scenarios, the percentage reduction and mass removal was higher during the dry year with 79% and 81%, respectively, when the LRI was around 42 g-N/m^{2}yr. In comparison, the wet year percentage reduction is 65%, the mass removal is 63% and 66 g-N/m^{2}yr for LRI. However, the areal mass removal was higher during the wet year with 66 g-N/m^{2}yr (dry year of 37 g-N/m^{2}yr) *(Table 7)*. This relation confirms the dependence between high LRI and high areal mass removal. Comparing these two scenarios with the normal year *(Fig. 6)*, the dry year has a similar outlet concentration to the normal year due to the increment in residence time of 17 days. Nitrates reduced by denitrifying bacteria also accelerates under high residence time.

Lastly, the comparison of the effect of nitrate removal between 30 and 10-acres wetlands showed a lower outlet concentration for the 10-acres wetland *(Fig. 7).* The 10-acres normal year model in average has lowest mass removal and

percentage reduction, 47% and 45%, respectively, compared to the 30-acres model of 78% and 76%. But it has higher areal mass removal of 67 g-N/m^{2}yr due to its high LRI of 144 g-N/m^{2}yr (*Table 8).* NICE WORK HERE

Total Phosphorus

Phosphorus (P) is greatly found in pesticides since it is a micronutrient needed by plants and algae to grow. However, agricultural runoff leads to P pollution to lakes and rivers causing eutrophication. In wetlands, P removal has two forms, a short-term sink and a long-term sink. Short-term removal includes precipitation of minerals and sorption to soil surfaces, while the long-term and the most important mechanism is plant uptake and burial which results in the accretion of soil and peat (*Kadlec and Wallace, 2009*). The short-term mechanisms have finite P retention capacities and combined with the asynchronous seasonal patterns of plant uptake and release from plants, known as the flywheel effect, control the timing and magnitude of P removal in the wetlands, and make it complex to study. The flywheel effect is the uptake and P storage (~10%) during the springtime when vegetation is growing, followed by the release back to the water column by decay of plant material in summer when the aboveground vegetation dies. Moreover, roots (belowground vegetation) during fall time store P to support the winter season before the spring growth (*Beutel et al., 2014).*

The initial TP concentration found at MD entering the wetland is 0.30 mg-P/L having an outlet concentration of 0.11 mg-P/L (0.26 after the 90th percentile is applied) in the normal year model, which is a 62% removal and 66% mass removal. The model also shows an areal mass removal of 5 g-P/m^{2}yr with LRI of 11 g-P/m^{2}yr and a residence time of 9 days (*Table 9*). These mass removal and areal mass removal are higher than typical values of 40 to 50% and 1 to 4 g-P/m^{2}yr. Moreover, the monthly rate constant variation shows that temperature is not really affecting P cycle. On the contrary, it is highly dependent on the plant uptake and burial behavior with is more seasonal in nature (*Fig. 8).* The model shows two peaks in the removal, one strong uptake during the growing season (spring), and a second high peak before winter, when the roots have the last uptake of nutrients to prepare for the cold winter conditions (*Fig. 9, 10*).

The comparison between dry and wet scenarios (*Table 9)* shows a better percentage reduction of 68% and mass removal of 74% during the dry year than 59% reduction and 53% mass removal of the wet year. However, the areal mass removal is almost equal, even if the LRI was higher for the wet year (22 g-P/m^{2}yr), showing that TP is not so dependent on the wetland´s loading. On the contrary, P removal mechanisms, sorption to particles, and accretion of soil can variate

depending on the hydrologic conditions. Hence, during the wet year, the amount of water entering the wetland does not allow a better removal because the residence time is low (7 days) compared to dry year which has a residence time of 14 days. More residence time of the water in the wetland allows the particles to settle down and P to be removed (*Fig. 11).*

The last comparison between the monthly 30-acres and 10-acres model *(Fig. 12)* shows a better mass removal (66%) and areal mass removal (5 g-P/m^{2}yr) for TP with the bigger area. The mass removal for the 10-acres model is 20%, and the areal mass removal is 2 g-P/m^{2}yr, which are fairly low values for wetland TP removal (*Table 11).* Moreover, the HRT of the 10-acres wetland was equal to the wet year model, 7 days. As mentioned before, hydrology is important for TP removal since it allows a better removal and controls some of P short-term mechanisms (sorption to soil surfaces) as turbidity is being reduced.

Conductivity

The key source of salinity in surface waters in Central Valley, CA is from pumping high salinity groundwater into surface channels. Groundwater was contaminated by saltwater intrusions and intense agricultural water application that leaches salts into the soil to the water table (State Water Resources Control Board, 2016). As a result, due to the weather conditions at Newman City, it is expected to see an increment in salinity concentration after the implementation of the wetland. Wetlands are mainly open areas that have evapotranspiration (ET) as one strong parameter that reduces the water volume. Thus, ET increments salinity concentration, while precipitation decreases it as salinity gets diluted. However, salinity (EC) during normal conditions was modeled to predict salinity behavior with the construction of the 30-acres wetland. The results show an income concentration of 662 µS/cm and an outlet concentration of 767 µS/cm. This is a 14% increment (*Table 12*), which makes both values below the 900 µS/cm limit for potable purposes (SWRCB, 2016), therefore, an acceptable value for the City purposes.

5. CONCLUSIONS

- Results from the normal year model showed a high mass removal of 78% for nitrate with a residence time of 9 days. The model also showed a huge dependence on temperature for nitrogen removal as it controls microbial activity. Therefore, denitrification, the transformation of nitrate to dinitrogen by bacteria is higher during summertime, the warmer months.

- Nitrogen removal is affected by high LRI generating high areal mass removal. This is seen during the wet year with 66 g-N/m^2yr (LRI of 71 g-N/m^2yr), compared to the dry year of 37 g-N/m^2yr, when the LRI was around 42 g-N/m^2yr. However, nitrate reduced by denitrifying bacteria also accelerates under high residence time. The dry year model showed similar removal compared to the normal year due to the increment in residence time from 9 days (normal year) to 17 days (dry year).

- For TP, the normal year scenario showed a 66% mass removal. Likewise, it was seen that plant uptake and burial is TP principal sink mechanism. Thus, P follows the annual plant seasonal cycle showing better removal during spring and autumn. However, P short-term mechanisms also have an influence in P removal, hence, there was a decrement in mass removal during the wet year.

- There is better removal for nitrate and TP under the 30-acres constructed wetland scenario compared to the 10-acres wetland scenario.

- The City of Newman has problems controlling salinity, not just due to agriculture, but because of the groundwater/watershed that has a naturally high concentration of salts. In the normal year model, conductivity increased by 14%, which should not impair the potential reuse of the water.

6. REFERENCES

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7. APPENDIX

Tables

NORMAL YEAR	Median Precipitation from NOAA (m/month)	Evapotranspiration from WRCC (m/month)	Total inflow (Qi) (m3/month)	Hydraulic retention time (τ) normal year (day)
January	0.05	0.04	226186	8
February	0.04	0.07	163643	11
March	0.03	0.14	365822	5
April	0.02	0.24	327991	6
May	0.00	0.36	269487	8
June	0.00	0.42	255989	8
July	0.00	0.45	264522	8
August	0.00	0.40	264522	8
September	0.00	0.30	255989	8
October	0.01	0.19	292826	7
November	0.03	0.08	117942	16
December	0.03	0.05	144252	13
Average	**0.02**	**0.23**	**245,764**	**9**

Table 1. Normal year hydraulic model for Newman City prospected wetland

Water Quality Summary	
Total P (mg-P/L)	0.27
PO4 (mg-P/L)	0.14
NH3 (mg-N/L)	0.17
NO3 (mg-N/L)	1.87
Conductivity (us/cm)	662
TSS (mg/L)	81
Do (mg/L)	5.39
pH	7.29
T (°C)	24

Table 2. Averge water quality concentration at Miller Ditch in Newman City, CA.

Month	Total inflow (Qi) 20% (m3/month)	Precipitation 20% (m/month)	Total inflow (Qi) 80% (m3/month)	Precipitation 80% (m/month)
January	102540	0.022	401476	0.099
February	52212	0.010	349360	0.086
March	290343	0.007	514793	0.064
April	277838	0.006	396021	0.036
May	264522	0	321727	0.015
June	255989	0	261550	0.001
July	264522	0	264522	0
August	264522	0	264522	0
September	255989	0	278831	0.006
October	264522	0	358870	0.024
November	40279	0.007	216859	0.052
December	56856	0.011	308915	0.075
Average	**199,178**	**0.005**	**328,120**	**0.038**

Table 3. Dry (20%) and wet (80%) year hydraulic scenarios used for the P-K-C*model for pollutant removal in Newman City, CA (NOAA)

MONTHS	Miller Ditch flow (Q_{MD}) (m^3/month)	Agriculture land runoff (Q_{AR}) (m^3/month)	C_{in} averaged Nitrate (mg/L)	C_{in} averaged TP (mg/L)
January	15,144	211,042	2.14	0.34
February	13,679	149,964	2.13	0.34
March	264,522	101,300	1.95	0.29
April	255,989	72,003	1.93	0.29
May	264,522	4,966	1.87	0.27
June	255,989	0	1.87	0.27
July	264,522	0	1.87	0.27
August	264,522	0	1.87	0.27
September	255,989	0	1.87	0.27
October	264,522	28,304	1.90	0.28
November	14,656	103,287	2.12	0.34
December	15,144	129,108	2.13	0.34
Average			**1.97**	**0.30**

Table 4. Inlet concentration to the prospected wetland at Newman City

	Temperature [°C]	Nitrate k-values (m/yr)	TP k-values (m/yr)
January	9	13	10
February	12	17	12
March	14	21	18
April	17	29	45
May	21	44	40
June	25	67	26
July	28	92	20
August	26	75	25
September	24	61	28
October	19	36	35
November	13	19	27
December	9	13	11
Average	**18**	**41**	**25**

Table 5. Nitrate and TP rate constants values (k) for prospected wetland in Newman City, CA

Nitrate Normal Year	Total inflow (Qi) (m3/month)	Cin (mg/L)	K (m/yr)	Co (mg/L)	% REDUCTION	%MASS REMOVAL	AREAL MASS REMOVAL (g/m2*day)	LRI [q*Ci] (g/m2*yr)	90th percentile Co
January	226,186	2.1	13	1.2	42	42	20	47	2.1
February	163,643	2.1	17	0.9	60	61	21	35	1.5
March	365,822	2.0	21	1.0	50	53	38	72	1.7
April	327,991	1.9	29	0.7	64	68	43	64	1.2
May	269,487	1.9	44	0.3	83	87	44	51	0.6
June	255,989	1.9	67	0.1	92	94	45	48	0.2
July	264,522	1.9	92	0.1	96	97	48	50	0.1
August	264,522	1.9	75	0.1	93	95	47	50	0.2
September	255,989	1.9	61	0.2	91	92	44	48	0.3
October	292,826	1.9	36	0.5	75	77	43	56	0.8
November	117,942	2.1	19	0.5	74	76	19	25	1.0
December	144,252	2.1	13	1.0	54	55	17	31	1.7
Average	**245,764**	**1.97**	**41**	**0.5**	**73**	**75**	**36**	**48**	**0.96**

Table 6. Monthly normal year for nitrate reoval using the P-K-C* model for the prospected treatment wetland at Newman City, CA

Wet Year Annual		Dry Year Annual	
NO3		NO3	
Ci	1.97	Ci	1.97
Co	0.77	Co	0.43
% REDUCTION	64	% REDUCTION	80
%MASS REMOVAL	62	%MASS REMOVAL	82
LRI [q] (g/m2*yr)	71	LRI [q] (g/m2*yr)	43
90th percentile	1.35	90th percentile	0.76
AREAL MASS REMOVAL (g/m2*yr)	45	AREAL MASS REMOVAL (g/m2*yr)	39

Table 7. Summary of the monthly dry and wet scenarios in a year using the P-K-C* model for the prospected treatment wetland at Newman City, CA

Normal Year Annual, 10-acres	
NO3	
Ci	1.97
Co	1.10
% REDUCTION	45
%MASS REMOVAL	47
LRI [q] (g/m2*yr)	144
90th percentile	1.92
AREAL MASS REMOVAL (g/m2*yr)	67

Normal Year Annual, 30-acres	
NO3	
Ci	1.97
Co	0.49
% REDUCTION	76
%MASS REMOVAL	78
LRI [q] (g/m2*yr)	48
90th percentile	0.85
AREAL MASS REMOVAL (g/m2*yr)	37

Table 8. Summary of the monthly normal year scenarios in a year with 10 and 30-acres using the P-K-C* model for the prospected treatment wetland at Newman City, CA

TP	Cin (mg/L)	K (m/yr)	Co (mg/L)	% REDUCTION	%MASS REMOVAL	AREAL MASS REMOVAL (g/m2*day)	LRI [q*Ci] (g/m2*yr)	90th percentile
January	0.34	10	0.22	34	34	3	10	0.51
February	0.34	12	0.16	52	53	3	17	0.37
March	0.29	18	0.17	44	46	5	15	0.38
April	0.29	45	0.07	75	78	7	13	0.16
May	0.27	40	0.06	78	82	6	10	0.14
June	0.27	26	0.09	66	75	5	9	0.21
July	0.27	25	0.10	64	73	5	9	0.23
August	0.27	25	0.10	64	72	5	9	0.23
September	0.27	28	0.09	69	75	5	9	0.20
October	0.28	35	0.08	71	74	6	11	0.18
November	0.34	25	0.06	83	84	3	15	0.13
December	0.34	11	0.16	53	54	3	8	0.36
Average	**0.30**	**25**	**0.11**	**63**	**67**	**5**	**11**	**0.26**

Table 9. Monthly normal year scenario for TP removal using the P-K-C* model for the prospected treatment wetland at Newman City, CA

Dry Year Model			Wet Year Model	
TP			**TP**	
Ci	0.30		**Ci**	0.30
Co	0.09		**Co**	0.12
%REDUCTION	68		**%REDUCTION**	59
%MASS REMOVAL	74		**%MASS REMOVAL**	53
LRI [q] (g/m2*yr)	6		**LRI [q] (g/m2*yr)**	22
90th percentile	0.22		**90th percentile**	0.29
AREAL MASS REMOVAL (g/m2*yr)	4		**AREAL MASS REMOVAL (g/m2*yr)**	5

Table 10. Monthly dry and wet scenario yearly averaged for TP removal using the P-K-C* model for the prospected treatment wetland at Newman City, CA

Normal Year 10-acres Model			Normal Year 30-acres Model	
TP			**TP**	
Ci	0.30		**Ci**	0.30
Co	0.19		**Co**	0.11
%REDUCTION	19		**%REDUCTION**	62
%MASS REMOVAL	20		**%MASS REMOVAL**	66
LRI [q] (g/m2*yr)	11		**LRI [q] (g/m2*yr)**	11
90th percentile	0.44		**90th percentile**	0.26
AREAL MASS REMOVAL (g/m2*yr)	2		**AREAL MASS REMOVAL (g/m2*yr)**	5

Table 11. Normal monthly scenario yearly averaged for TP removal using the P-K-C* model for the prospected treatment wetland varying the area between 30 and 10 acres at Newman City, CA

Normal Year Salinity			
	Qin (m3/mo)	Qin (m3/d)	
	245764	8192	
	S (µS/cm)	Qin (m3/day)	Qout (m3/day)
Sin (mg/L)	662		
Tank 1	685	8192	7912
Tank 2	711	7912	7633
Tank 3	738	7633	7353
Tank 4	767	7353	7074
So (mg/L)	767		
LRI (g/m2yr)	16305		
% REDUCTION	-16		
%MASS REMOVAL	-4		
AREAL MASS REMOVAL (g/m2*yr)	-78257539		

Table 12. Normal year salinity model for the prospected treatment wetland at Newman City, CA

Figures

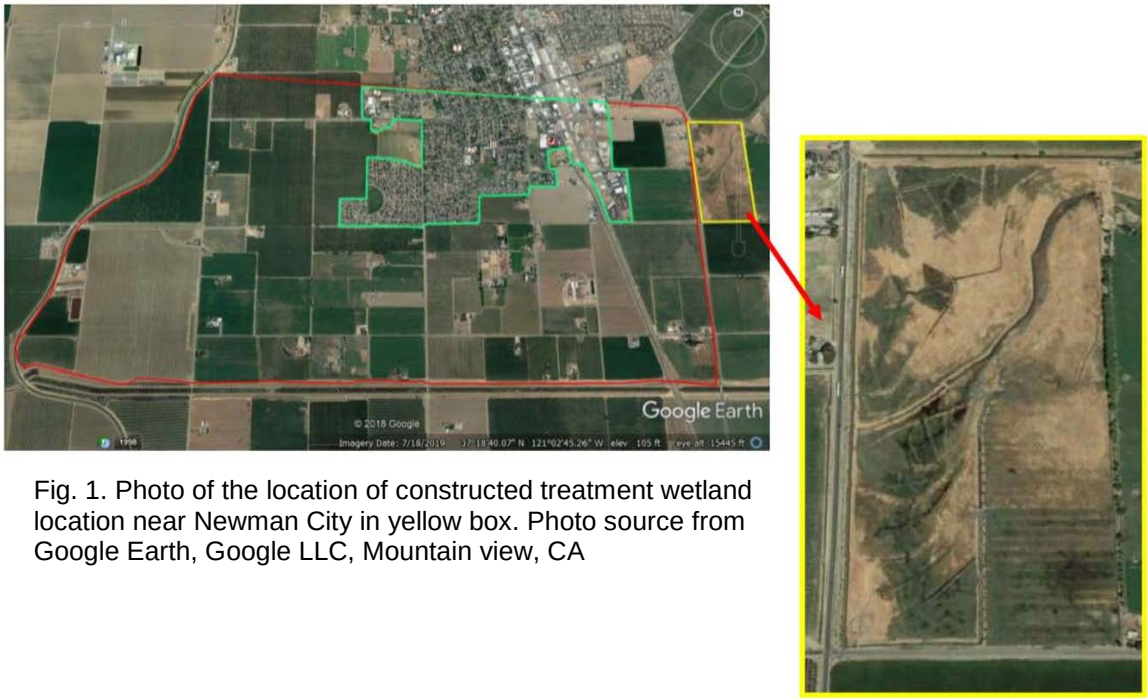

Fig. 1. Photo of the location of constructed treatment wetland location near Newman City in yellow box. Photo source from Google Earth, Google LLC, Mountain view, CA

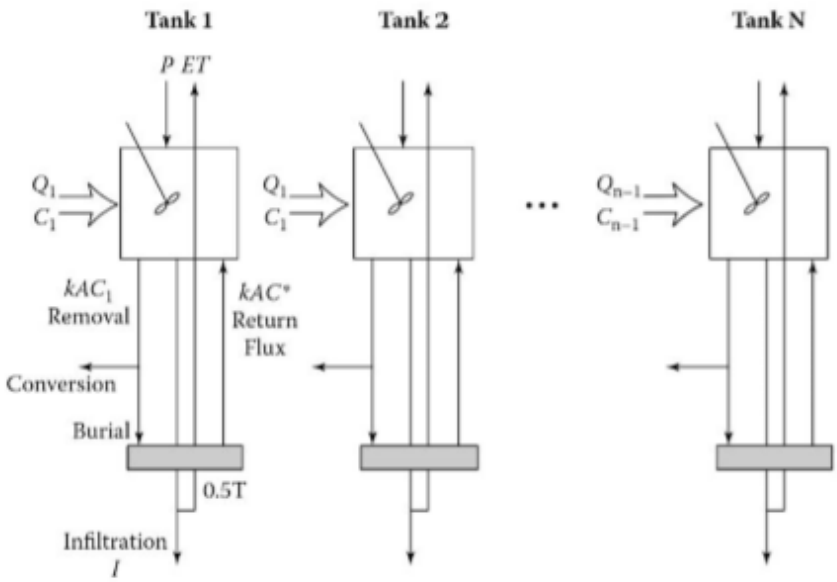

Fig. 2. Tank and series model for pollutant removal P-K-C* (Kadlec and Wallace, 2009)

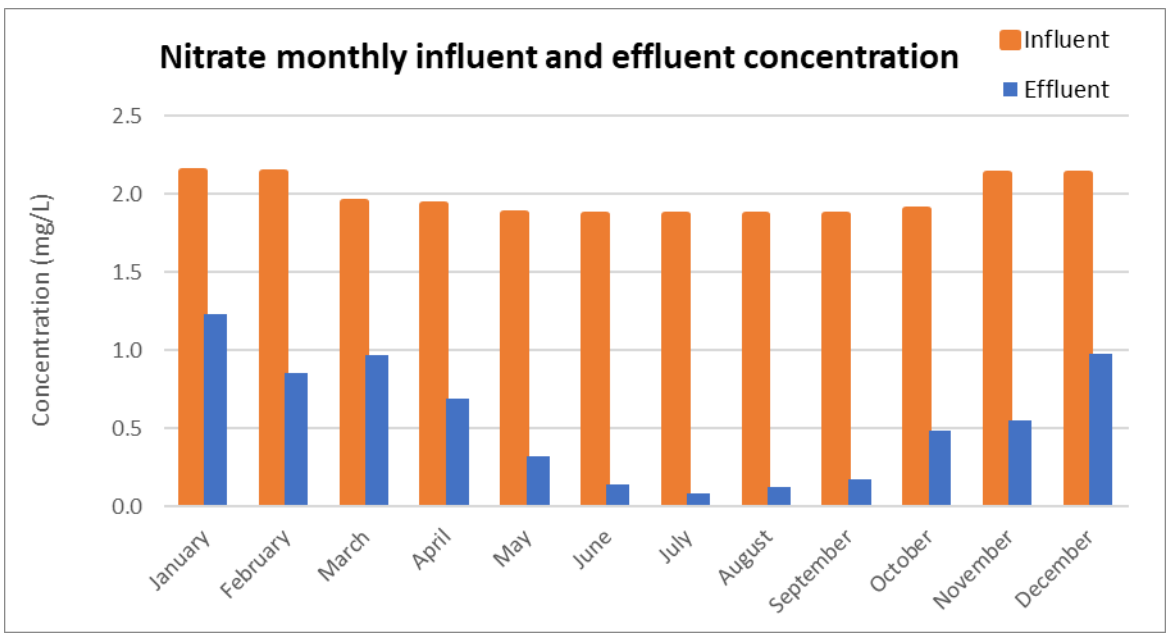

Fig. 3. Monthly normal yearly averaged model showing nitrate inlet and outlet concentration for a year in the prospected treatment wetland at Newman City, CA.

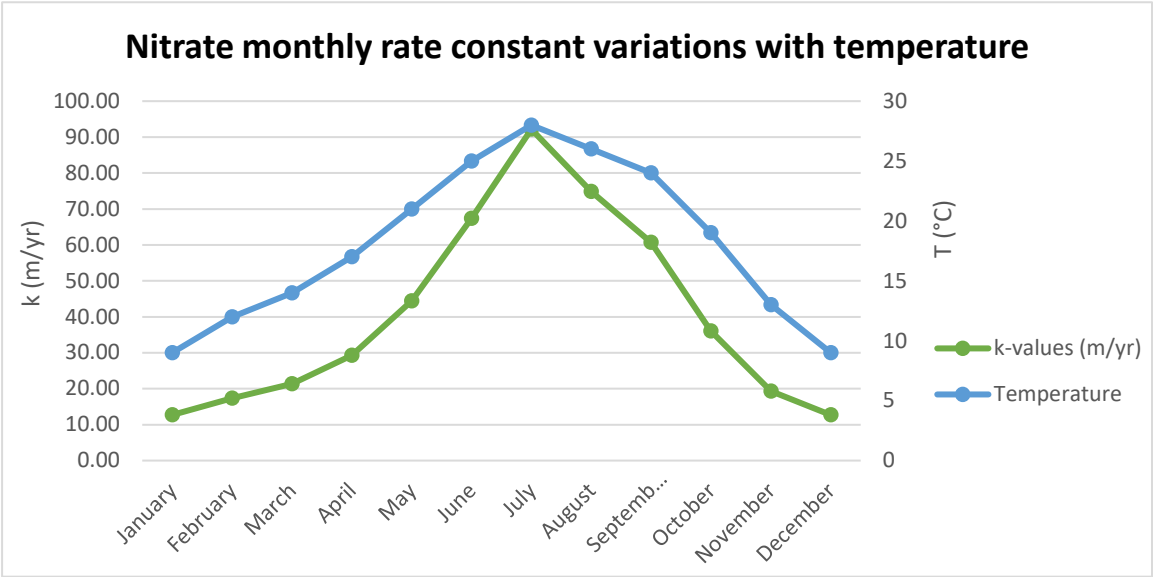

Fig. 4. Nitrate monthly rate constant variation with temperature for the prospected treatment wetland at Newman City, CA.

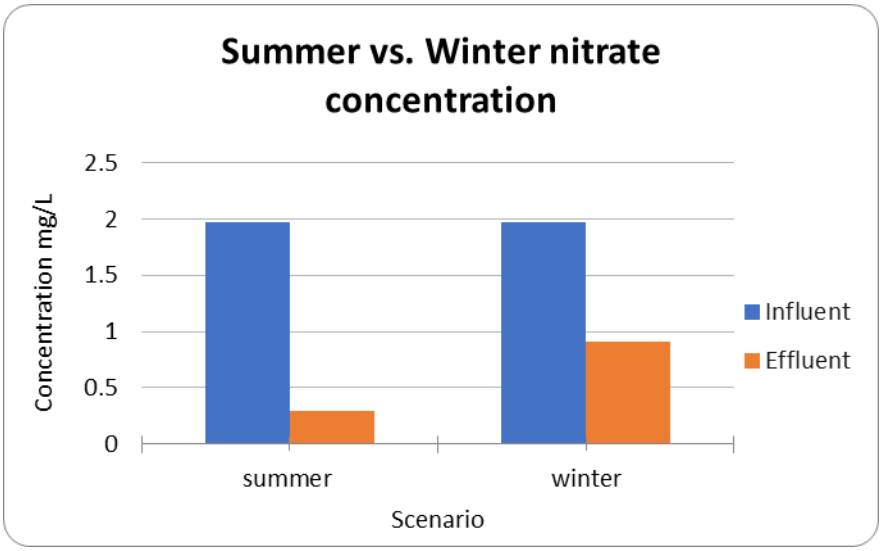

Fig. 5. Nitrate monthly normal scenario showing the seasonality between summer and winter time for the prospected treatment wetland at Newman City, CA.

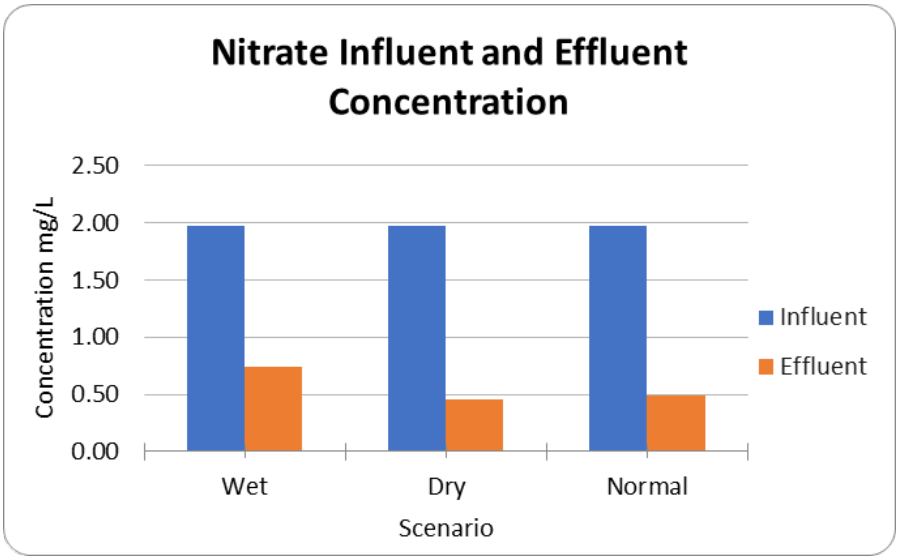

Fig. 6. Nitrate monthly yearly averaged scenarios showing the difference between wet, dry, and normal models for the prospected treatment wetland at Newman City, CA.

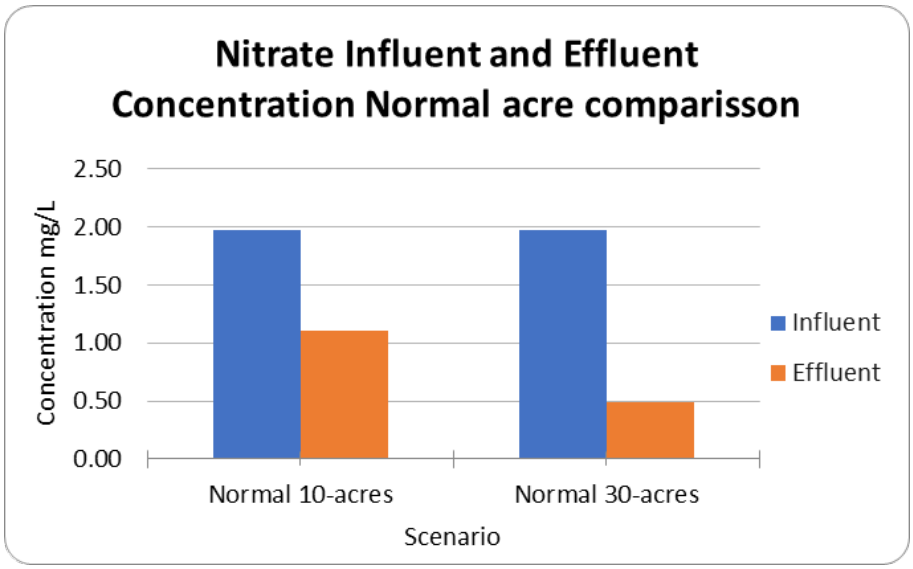

Fig. 7. Nitrate monthly normal scenarios yearly averaged showing the difference between 10-acreas and 30-acres of area of the outlet concentration for the prospected treatment wetland at Newman City, CA.

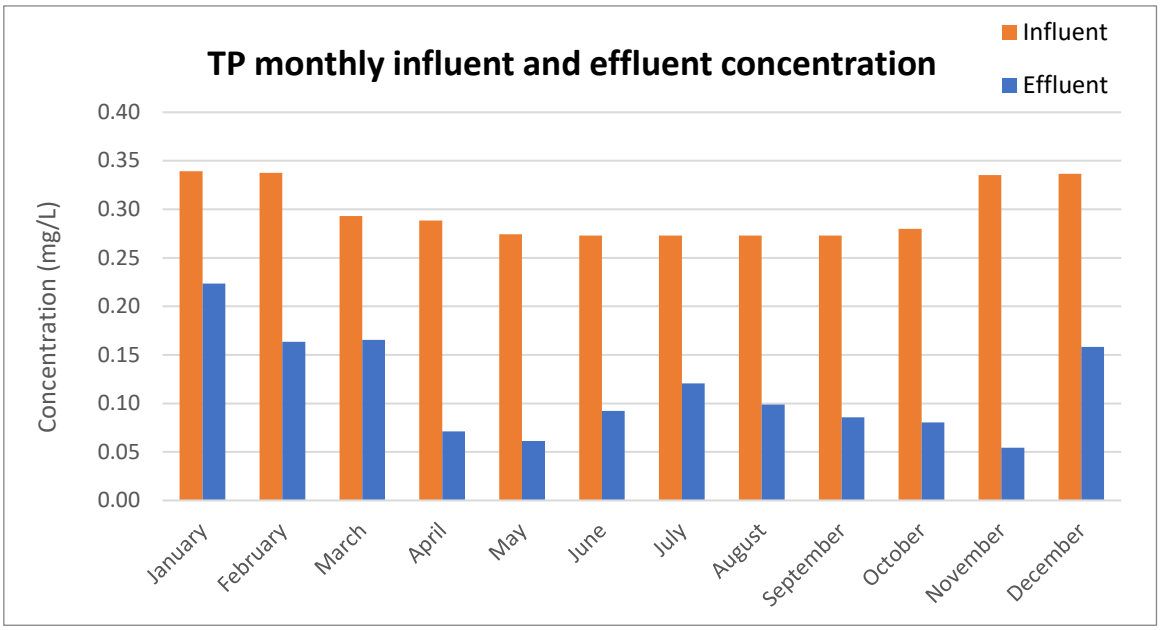

Fig. 8. Monthly normal yearly averaged model showing TP inlet and outlet concentration for a year in the prospected treatment wetland at Newman City, CA.

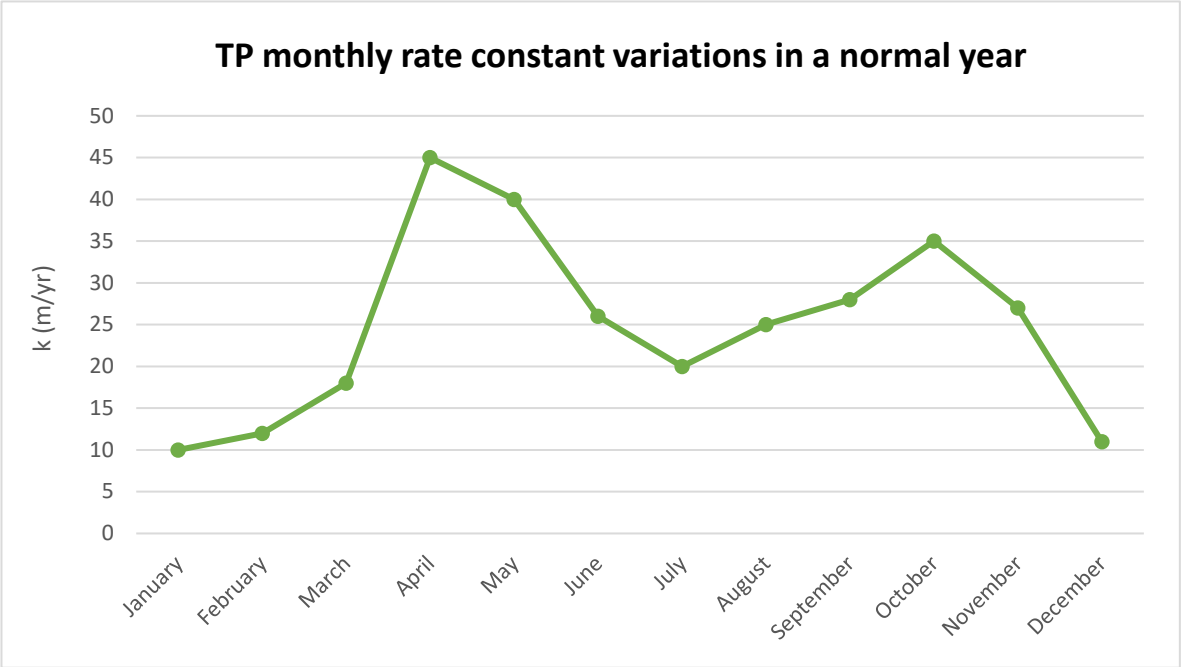

Fig. 9. TP monthly rate constant variation for the prospected treatment wetland at Newman City, CA.

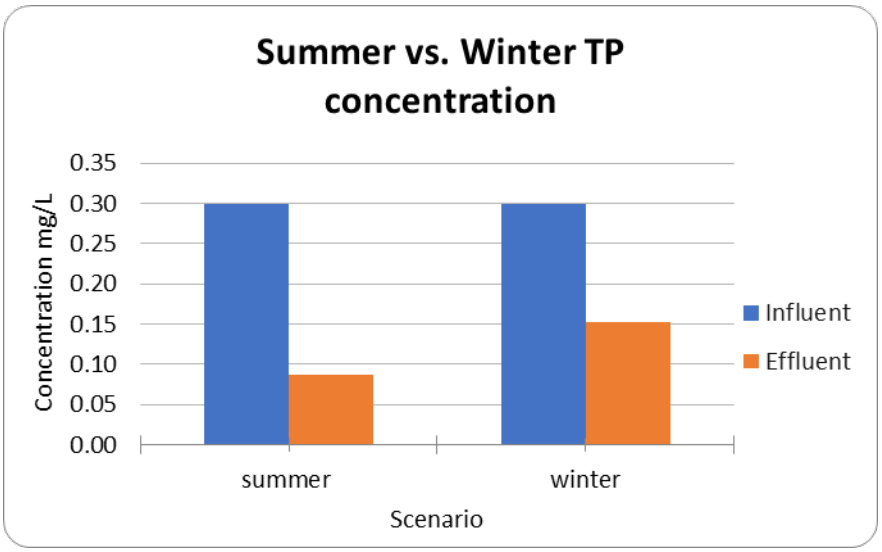

Fig. 10. TP monthly normal scenario showing the seasonality between summer and winter time for the prospected treatment wetland at Newman City, CA.

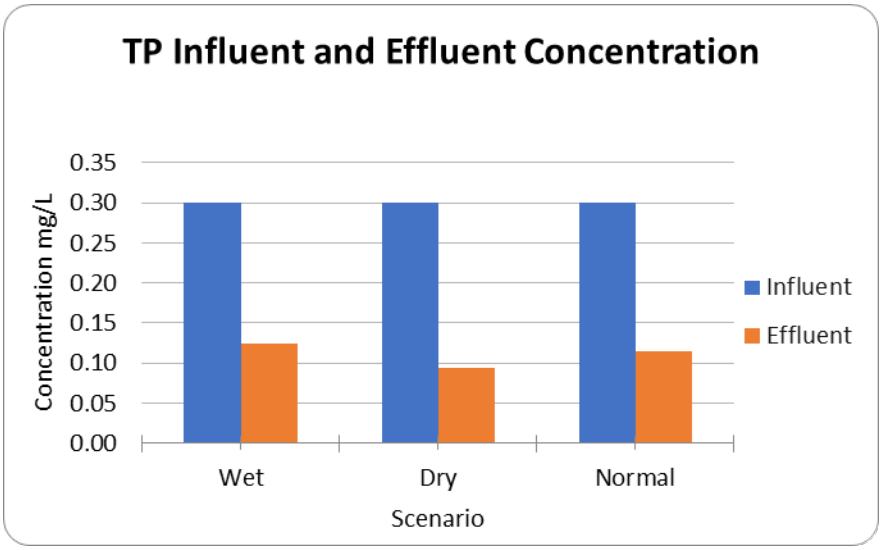

Fig. 11. TP monthly yearly averaged scenarios showing the difference between wet, dry, and normal models for the prospected treatment wetland at Newman City, CA.

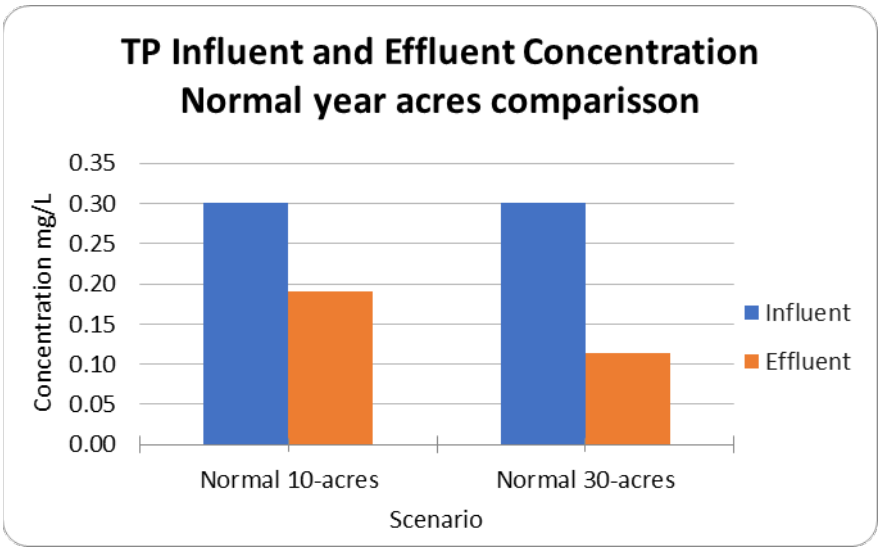

Fig. 12. TP monthly normal scenarios yearly averaged showing the difference between 10-acreas and 30-acres of area of the outlet concentration for the prospected treatment wetland at Newman City, CA.

MILLER DITCH TREATMENT WETLAND (MDTW)

HYDROLOGY MASS BALANCE AND POLLUTANT REMOVAL MODELING

Naivy Dennise Rodal Morales and Dr. Marc Beutel

**TABLES UPDATED NEW AREA: 15.8-ACRES.

Month	Irrigation flow (QIR) (m3/day)	Agriculture land runoff (QAR) (m3/day)	Total inflow Miller Ditch (QMD) (m3/day)	Precipitation into wetland (PP) (m3/day)	Evapotranspiration from wetland (ET) (m3/day)	Outflow (Qo) (m3/day)	Hydraulic retention time (τ) (day)
January	0	6,808	6808	112	83	6837	4
February	0	5,356	5356	88	158	5286	5
March	0	3,268	3268	54	286	3035	9
April	500	2,400	2900	39	507	2432	10
May	484	160	644	3	745	0	-
June	500	0	500	0	900	0	-
July	2,419	0	2419	0	938	1481	14
August	7,097	0	6774	0	821	5953	4
September	7,333	0	7000	0	645	6355	4
October	484	913	1397	15	394	1018	23
November	0	3,443	3443	56	181	3318	8
December	0	4,165	4165	68	96	4137	6
Annual average	**1,568**	**2,209**	**3,723**	**36**	**479**	**3,321**	**9**

Table 1. Calculated normal year water balance for the 15.8-acres MDTW new coneptual design

Normal Year- Sinuosity 15.8-acres			
	NO3	**TP**	**Salinity [uS/cm]**
Ci [mg/L]	2.03	0.31	711
Co [mg/L]	0.75	0.15	800
% Reduction	66	53	
Salinity Increment %			12
Residence time [day]	9		
Inflow [m3/day]	3,723		
Outflow [m3/day]	3,321		

Table 2. Summary of the monthly models averaged in a year for the 15.8-acres MDTW with sinuosity design

February 10th, 2021