Luhdorff & Scalmanini
Consulting Engineers

Technical Memorandum

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SUBJECT: **WILD WINGS COUNTY SERVICE AREA (CSA) PUBLIC WATER SYSTEM ARSENIC TREATMENT SYSTEM DESIGN**
TASK 1 – PRODUCTION AND DEMAND ANALYSIS

1. INTRODUCTION

This memorandum summarizes the estimated water requirements for the Wild Wings County Service Area (CSA) water system based on a review of available water production records. Luhdorff and Scalmanini Consulting Engineers (LSCE) has prepared this memorandum for the County of Yolo (County) in accordance with Task 1 of the Arsenic Treatment Design at Wild Wings CSA. The water demand established in this memorandum provides a basis for arsenic treatment system sizing and other water facility modifications that will be developed in subsequent tasks.

2. WATER SYSTEM AND SUPPLY WELLS

Wild Wings CSA is a suburban community of 337 residences and a population of approximately 913. The water system supplies potable domestic water and non-potable water, as summarized in this memorandum. The drinking water system supplies potable water to the residential service connections, the community center buildings and common landscape areas. The potable water system is regulated by the State Water Resources Control Board Division of Drinking Water (SWRCB-DDW) public water supply permit. The non-potable water system supplies supplementary water for the community golf course landscape irrigation and for stormwater retention ponds that require water during dry months for mosquito abatement and aesthetics.

The water system has two groundwater supply wells. Pintail well is rated at a capacity of 1,100 gpm and Canvas Back well is rated at a capacity of 1,200 gpm. Both wells produce water containing some levels of arsenic, which is a naturally occurring chemical that occurs in the earth's crust and is a regulated contaminant in drinking water. California revised the primary Maximum Contaminant Level (MCL) for arsenic in 2008 lowering it from 50 micrograms per liter (µg/L) to 10 µg/L. Water quality records from 2003 to 2017 indicate the arsenic levels in the Canvas Back well are typically above the MCL with a range of 7 µg/L to 15 µg/L. Arsenic levels in the Pintail well are consistently below the MCL with a range of 5.7 µg/L to 8.8 µg/L.

In 2009, the Canvas Back well was placed on "emergency standby" status by the SWRCB-DDW due to having arsenic concentrations above the MCL. Since then the Canvas Back well has been dedicated to providing the non-potable water requirements or used for domestic water only during periods when the Pintail well is offline for maintenance. The emergency standby status limits the use of the Canvas Back well in the domestic system to a maximum of five consecutive days of operation or 15 total days out of the year. This impacts the reliability of water supply as there are many circumstances for well and pump maintenance that will require more than five consecutive days of downtime, sometimes significantly longer such as if there is well failure. Recently, the Pintail well had to be taken offline for pump repairs and it was a challenge to complete the work effectively in the 5-day time period.

As a first step in the arsenic treatment system design, LSCE analyzed the available water production records to define the water demand factors for average daily demand, maximum day demand and peak hour demand. The water demand factors for the potable and non-potable supplies are presented in this Technical Memorandum to establish a basis for arsenic treatment sizing and system upgrades that will be developed in subsequent tasks.

3. HISTORICAL DATA REVIEW

LSCE obtained and reviewed historical water production and reporting data, provided by the County and current operators of the Wild Wings CSA water system, Specialized Utilities Services Program (SUSP). A brief summary of the data provided is detailed below.

Scanned Operator Records (2005 – 2013)

LSCE reviewed hard-copy operator records from 2005 to 2013. These operator records include daily well and distribution flow meter totalizer readings for both Pintail and Canvas Back well sites, stormwater retention pond and recycle pond fill volumes, copies of laboratory analysis results and chain of custody information, storage tank chlorine residual records, vehicle mileage data, tank inspection records, operator logs, and Pacific Gas and Electric meter readings.

Electronic Annual Reports (2009 – 2018)

The water system electronic Annual Reports (eAR) from 2009 to 2018 have inconsistent data reporting. Annual potable production data, along with the maximum month potable production was provided for all years except 2009 and 2017. Monthly potable production was only provided for 2013 through 2016, and the majority of 2018. Non-potable monthly production was provided for 2013 and 2014. No details for production volumes were provided in the 2017 eAR.

Monthly Production Data (2018 – 2020)

SUSP provided recent information detailing metered usage, well production volumes, wastewater treatment plant effluent volumes, and volumes for recycle/irrigation. Additionally, the operator provided information regarding the maximum month and maximum day of production for each well in a given year. This data was provided for each month from April 2018 to February 2020.

Daily Production Data (2019)

In addition to the monthly production data provided by the current system operators, the Wild Wings CSA technical representative provided daily totalizer readings for both the Pintail and Canvas Back wells as well as storage tank chlorine residuals for January to August 2019.

4. POTABLE WATER DEMAND

The Wild Wings CSA water system has two production facilities that each consist of a groundwater production well, a 360,000-gallon water storage tank, two booster pumps, and a hydropneumatic tank which supplies water to the distribution system. Currently, the only treatment used for the potable water system is chlorine injection for disinfection. The storage tanks and booster pumps are used to meet the instantaneous peak water demands of the system while the production wells are used to fill the storage tanks. The wells are interconnected with a transmission main that can be used to fill the storage tanks from either production site.

In accordance with the California Waterworks Standards (Title 22), a public water system shall have adequate source capacity to meet the Maximum Day Demand (MDD) at all times. Additionally, community water systems using only groundwater shall be able to meet the MDD with the highest-capacity source offline. Thus, the Wild Wings CSA groundwater wells are required to be able to meet the MDD individually so that the MDD can still be met if one well is offline. The storage and boosters are used to supply the Peak Hour Demand (PHD) and store a reserve water volume for fire suppression.

Title 22 dictates that the MDD shall be determined using the most recent ten years of data. When daily production data is not available, the MDD can be determined using the maximum month of production over the most recent ten years of operation. Upon examination of the available records, LSCE found the most comprehensive dataset over the last ten years was the eAR data, but all of the records were used to fill as many of the data gaps as possible. The ten-year span of production records is summarized in Table 1 below.

Table 1: Wild Wings CSA Annual and Maximum Month Potable Production 2010 – 2019

Year	Annual Production[1] (MG)	Maximum Month	Maximum Month[1] (MG)
2019	85.0[a]	July	12.2[b]
2018	76.2	July	13.0
2017	no data	no data	no data
2016	89.9	July	12.7
2015	86.2	July	10.5
2014	95.0	July	12.3
2013	94.1	July	16.6[c]
2012	91.3	July	13.8
2011	87.3	August	13.4[c]
2010	90.3	July	14.5[c]

1 – All data from eARs unless otherwise noted
a – Annual production for 2019 from "Monthly Production Data (2018-2020)"
b – 2019 maximum month production from "Daily Production Data (2019)"
c – 2010, 2011, & 2013 maximum month production from "Scanned Operator Records (2005-2013)"

The prior 10-years of record indicates the average annual potable production is 88.4 million gallons (MG), which equates to an average daily demand (ADD) of 168 gallons per minute (gpm). There are 337 residential connections, which are referred here as equivalent dwelling units (EDU). The ADD equates to 0.5 gpm per EDU. The maximum month production was in July 2013 with 16.6 MG produced. However, this production value is an outlier as compared to the other historic maximum months by a factor of at least 20-percent. While the operators from that period are not available to clarify what may have caused

this outlier, it is apparent from the historical maximum month data that it is not reflective of normal system operation and is therefore omitted from the analysis of water demand.

Starting in 2015, water conservation practices were first implemented in the Wild Wings CSA to comply with a mandatory reduction of 25% water consumption as imposed by the California governor in response to the state-wide drought. Annual production decreased in 2015 with the onset of the mandated conservation practices and have not rebounded to the pre-conservation volumes, indicating conservation practices have persisted even with the relaxation of government-mandated conservation.

Prior to 2015 (i.e. pre-conservation), the maximum month was 13.8 MG (discarding the outlier in July 2013). In comparison, after 2015 (i.e. post-conservation), the maximum month of production is 13.0 MG, which is a reduction of approximately 6-percent from the pre-conservation water demands. Using the post-conservation maximum monthly demands as a basis and applying a peaking factor of 1.5 as required in Title 22, the MDD is determined to be 0.63 MGD or 437 gpm represented as an average flow on the maximum day (or 2.6 times the ADD). The PHD of the system is determined by applying a peaking factor of 1.5 again per Title 22, for a PHD of 655 gpm.

During the original planning for the Wild Wings community, LSCE along with Nolte Engineers prepared a design basis to estimate the community's water demands for the purposes of sizing the water system infrastructure. This design basis estimated the total MDD for the Wild Wing CSA potable water system was approximately 376 gpm, which included the supply of potable water to customer service connections, irrigation for common landscape areas, and other potable service connections.

Wild Wings CSA recently added a new potable water service to the Watts-Woodland Airport, which increases the estimated potable demand. The Wild Wings CSA development is completely built-out with no plans for expansion or consolidation, beyond this new service connection to the airport. LSCE previously analyzed the Watts-Woodland Airport water demand arriving at a decision to install a 3-inch service connection. The water uses at the airport consist of a caretaker's house, restrooms in several of the hangars, a small kitchen, and small irrigated landscape areas. LSCE documented approximately 92 Water Supply Fixture Units (WSFU) as defined in the Plumbing Code, which equates to an instantaneous design flow of 40 gpm per Plumbing Code standards. By comparison, 92 WSFU would be equivalent to three typical residential households. For purpose of estimating total water use, the new service is conservatively estimated to be 5 EDUs (i.e. 5 households worth of water use) to determine the increase in ADD and MDD requirements. The PHD will be assigned a value of 40 gpm per Plumbing Code.

Considering the increase in EDUs from 337 to 342 with the airport connection, the total estimated potable water requirements are as follows:

- Average Day Demand (ADD) = 171 gpm
  Basis: 0.50 gpm/EDU times 342 total EDUs)

- Maximum Day Demand (MDD) = 445 gpm
  Basis: 2.6 times the ADD

- Peak Hour Demand (PHD) = 695 gpm
  Basis: the original PDH of 655 gpm plus the 40 gpm peak flow from Watts-Woodland Airport.

5. NON-POTABLE WATER DEMAND

The non-potable water uses in the community include irrigation for the community golf course landscaping and infrequent filling of stormwater retention ponds. The non-potable water demand is met by a combination of tertiary effluent from the Wild Wings CSA wastewater treatment plant (WWTP), accumulated precipitation runoff, and supplemental groundwater from the production wells. Both production wells connect to a raw water main that delivers to the to recycle water pond (for golf course irrigation) and the stormwater retention ponds.

The community golf course irrigates from a recycle water pond, which is filled from tertiary effluent from the WWTP and supplemental groundwater from the production wells.

The golf course ponds have not been filled with groundwater since 2016 due to the mandatory water conservation practices during the drought, with the exception of the pond at the community entrance.

The stormwater retention ponds capture the precipitation runoff within the community to prevent flooding. These ponds are located in the front entrance to the community and throughout the golf course. Over the summer months when precipitation is low, the stormwater retention ponds become shallow, stagnant ponds, creating excellent breeding grounds for mosquitos. Therefore, for heath and aesthetic purposes, the Wild Wings CSA water system operators are have historically filled these ponds during the summer months with raw groundwater.

During the original planning for the Wild Wings community, LSCE along with Nolte Engineers prepared a design basis to determine the community's raw water demands that considered the anticipated WWTP effluent volumes, precipitation, evapotranspiration, percolation, runoff estimates, and pond evaporation estimates. Based on this evaluation, LSCE and Nolte Engineers estimated that in the anticipated maximum month of July, the Wild Wings groundwater wells would supply 19.9 MG of raw water to supplement the WWTP effluent and approximately 3.8 MG of raw water to refill the stormwater ponds to offset evaporative and percolation losses. These two uses comprise an estimated total raw water production of 23.7 MG in a maximum summer month (July), equating to approximately 0.76 MGD assuming equal raw water demands throughout the month.

The Canvas Back well was solely used for the non-potable water demand starting in 2009. Daily production records from the "Scanned Operator Records (2005-2013)" for the Canvas Back well were reviewed to assess non-potable demands. For the Canvas Back well, LSCE reviewed the records for the maximum month production, the number of days of well operation in the maximum month, the total daily production in the maximum month, and the number of hours the well operated between record collection. Table 2 below provides a summary of the Canvas Back well operation from 2009 to 2013 along with a comparison to the original design basis estimates for non-potable usage.

Table 2: Canvas Back Operation (2009 – 2013)

Year	Maximum Monthly Production (MG)	# Days in Operation	Average Daily Volume During Operation (MG)	Maximum Daily Production (MG)
2009	18.5	15	1.23	1.54
2010	18.9	22	0.86	1.28
2011	14.8	14	1.06	1.85
2012	12.4	15	0.82	1.42
2013	13.8	15	0.92	1.12
Average:	**15.7**	**16**	**0.98**	**1.44**

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The actual groundwater production from the Canvas Back well to meet non-potable demands in this time period ranged from 12.4 MG per month to 18.9 MG per month, which are lower than the original design basis of 23.7 MG per month. When groundwater has been used to supplement the non-potable water needs, it has occurred on average for 16 days out of the month. When the well was used to meet irrigation non-potable demands, it would produce on average 0.98 MGD. Over a 24-hour period this equates to an average continuous flow rate of 680 gpm. However, maximum daily production of record was 1.85 MGD, which is an average continuous flow of 1,285 gpm.

While the timing of potable demands is dictated by community domestic water use, the timing of non-potable irrigation production can be controlled to occur during off-peak hours of the day or days where domestic production is lower. Therefore, the average daily volume for non-potable production (0.98 MGD or 680 gpm daily flow), is appropriate as the basis for determining the required daily volume from the well, in addition to the daily requirements that must be met on the domestic potable water. Based on Table 2, an average non-potable production of 0.98 MG is anticipated during July, the month of peak non-potable usage. The well could produce the average daily production if operated continuously for a 24-hour period at a flow of approximately 680 gpm.

6. CONCLUSIONS

Considering the historical records and including the new water service connection to the airport, the Wild Wings CSA potable water system has an MDD of 0.64 MGD (445 gpm) and a PHD of 695 gpm. The existing water storage and booster pumps provide the instantaneous flow rates to meet demands in the system, while the wells must be sized at a minimum to meet the MDD for filling of the tanks. This consideration will be made in the arsenic treatment system sizing to ensure at a minimum there will be treated water that meets all water quality requirements in sufficient capacity to meet the MDD of the system.

Non-potable demands are currently supplied by the Canvas Back well but when the arsenic treatment facility is brought online, both the Canvas Back and Pintail wells will be available to supply potable or non-potable water. The non-potable water demand typically peaks in July with an average daily production volume of 0.98 MGD (an average daily flow of 680 gpm). The daily irrigation supply from the wells can be timed during periods of the day when the wells are not needed for domestic supply.

Table 3 provides the water requirements that will be used as a basis in the subsequent tasks for the sizing on an arsenic treatment system to meet the potable MDD and determination of other controls and upgrades that may be required to meet both potable and non-potable demands.

Table 3: Summary of Water Requirements

Water Uses	Maximum Day Demand (MDD)		Peak Hour Demand (PHD)
	MGD	gpm	gpm
Potable Demand (1)	0.64	445	695
Non-Potable Demand (2)	0.98	680	1,285
Total Water Demand	**1.62**	**1,125**	**(not additive)** [1]

1. The potable (domestic) water demand is supplied from the storage tank and booster pumps. The PHD instantaneous flows are met by the storage and booster, and the wells must meet MDD daily requirements to ensure the storage tank can stay full throughout the course of the day. The total system storage is adequate to provide the peaking needs.
2. The non-potable (irrigation) water is met directly from the wells. The PHD represents the maximum flow available from the wells, and the MDD represents daily volume anticipated for the irrigation supply. The wells must be able to each supply the daily requirements of the potable and non-potable (so the additive of the MDD for both demands). The PHD is not additive because the wells do not need to meet the PHD of the domestic system (it is met by storage as noted above).

7. NEXT STEPS

As outlined in LSCE's scope of work, the forthcoming Task 2 analysis will use the water demand information summarized above to develop and evaluate treatment system concepts. The treatment system concepts being developed will meet the objectives for water quality and water demand and will also consider the footprint, capital cost, operational costs, and varying combinations of blending and split-flow to reduce treatment size needed. Supporting figures, diagrams and literature will be included in this forthcoming analysis.